FlexRadio Systems®
Software Defined Radios

FLEX-6000 SIGNATURE SERIES

SMARTSDR SOFTWARE USER MANUAL

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Ty Coon, President of Vice

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3 KEY CONTACTS

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4 INSTALLING SMARTSDR FOR WINDOWS APPLICATION ON YOUR PC

The SmartSDR™ for Windows application is the software used to interface with the FLEX-6000 radio hardware for viewing spectrum and controlling the radio.

4.1 RECOMMENDATIONS AND REQUIREMENTS

Minimum recommended CPU for SmartSDR for Windows is the Intel® Core™ 2 Duo or AMD® Athlon™ 64 x2 processor. For optimal performance a quad core or greater CPU is recommended.

4.2 MINIMUM WINDOWS AND .NET REQUIREMENTS

SmartSDR is a Windows .NET Framework application designed to operate on Windows XP SP3, Vista, Windows 7 and Windows 8. The .NET Framework 4.0 Client Profile is required.

The minimum version of Windows supported by SmartSDR v1.2.0 and greater is Windows Vista Service Pack 2 (SP2). The SmartSDR v1.2.0 Installer will automatically detect your current Windows version and will notify you if it does not meet the minimum operating system requirements. SmartSDR will allow for installation on Windows XP SP3 with a warning that Windows XP is no longer supported by Microsoft or FlexRadio Systems. Upgrading XP to a Microsoft supported operating systems is recommended. If your Windows XP PC has not been upgraded to SP3, you must do so before installing SmartSDR.

If you need to install SP3 for Windows XP, install it before installing the .NET Framework 4.0 Client Profile. The easiest method for obtaining it is to use the Windows Update service. An optional update method is to download the SP3 update software via the Internet directly from Microsoft using this web link:

http://www.microsoft.com/en-us/download/details.aspx?id=24

Note: this is a very large download (approximately 316 MB) which may take over an hour to download using slower Internet connections.

If you need to install the .NET Framework 4.0 Client Profile, the SmartSDR for Windows Installer will automatically install it from the SmartSDR Installation CD or attempt to download the necessary software from the Internet if the CD is not available. Alternately, you can download it directly from Microsoft using this web link BEFORE installing SmartSDR for Windows.

http://www.microsoft.com/en-us/download/details.aspx?id=17113.

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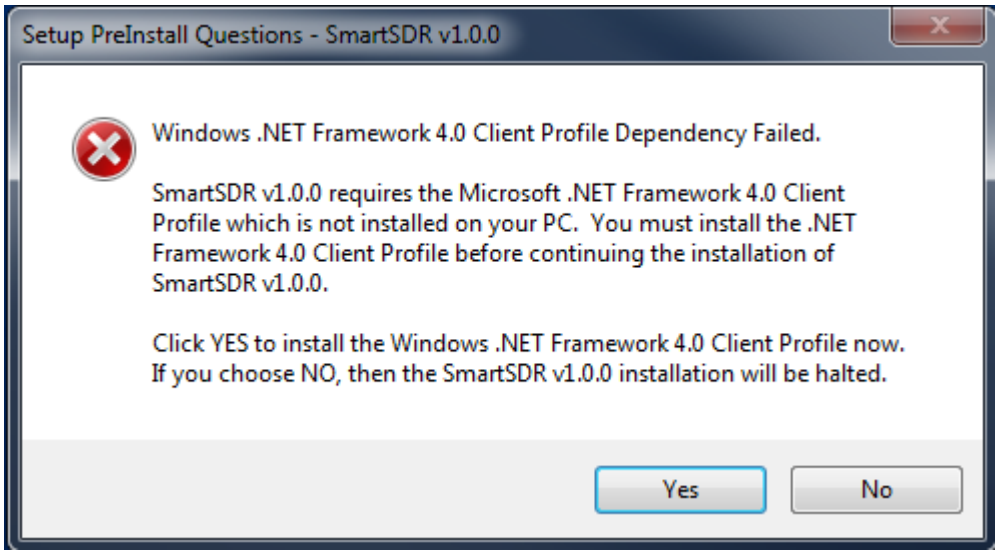
4.3 INSTALLING THE SOFTWARE

If you are installing SmartSDR for Windows from the CD, place it in your CD drive and close the drive door. The SmartSDR software installer will automatically begin. If you are installing SmartSDR for Windows from the installer downloaded from the Internet, double click on the SmartSDR installer (SmartSDR_v1.x.x_Installer.exe) to begin.

4.3.1 Step 1. Pre-Installation Tasks

The first thing the SmartSDR software installer will do is determine if your PC's operating system and installed .NET version meets the minimum requirements. If your PC does not have the required .NET Framework 4.0 Client Profile software loaded, the following Setup Pre-Install screen will be displayed.


Setup PreInstall Questions - SmartSDR v1.0.0
Windows .NET Framework 4.0 Client Profile Dependency Failed.
SmartSDR v1.0.0 requires the Microsoft .NET Framework 4.0 Client Profile which is not installed on your PC. You must install the .NET Framework 4.0 Client Profile before continuing the installation of SmartSDR v1.0.0.
Click YES to install the Windows .NET Framework 4.0 Client Profile now.
If you choose NO, then the SmartSDR v1.0.0 installation will be halted.
Yes
No

If you see this screen, click YES to install the .NET Framework 4.0 Client Profile software or click on NO to stop installing SmartSDR for Windows. If you are installing from the SmartSDR for Windows CD, and selected YES, the following screen will be displayed.

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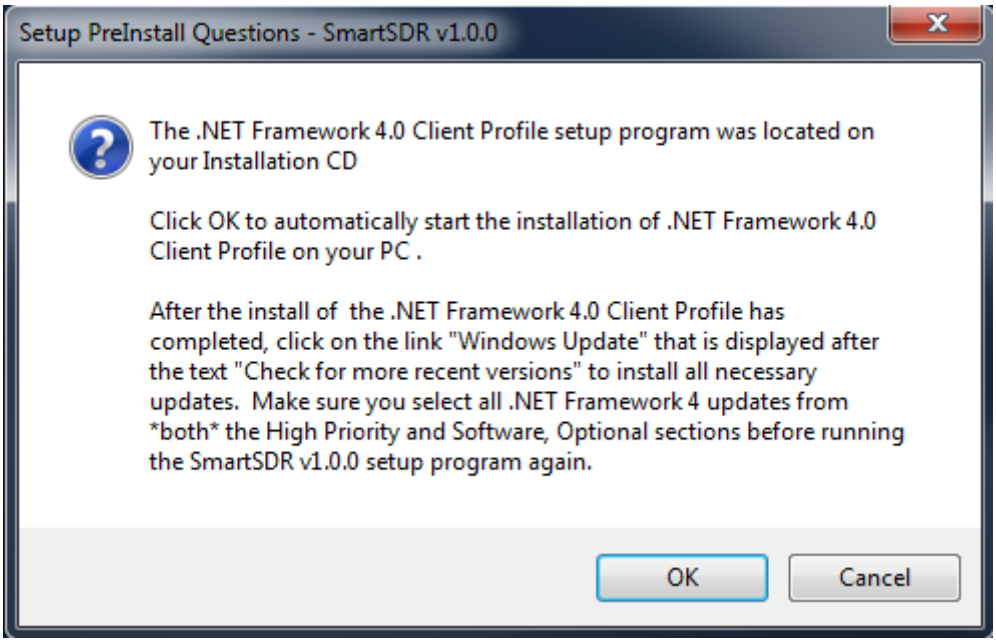
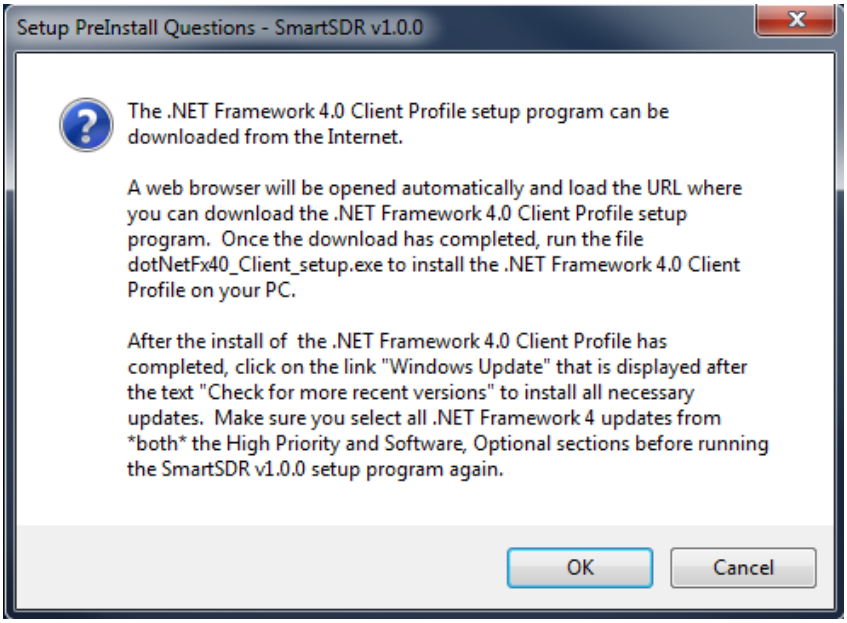

Setup PreInstall Questions - SmartSDR v1.0.0
The .NET Framework 4.0 Client Profile setup program was located on your Installation CD
Click OK to automatically start the installation of .NET Framework 4.0 Client Profile on your PC .
After the install of the .NET Framework 4.0 Client Profile has completed, click on the link "Windows Update" that is displayed after the text "Check for more recent versions" to install all necessary updates. Make sure you select all .NET Framework 4 updates from *both* the High Priority and Software, Optional sections before running the SmartSDR v1.0.0 setup program again.
OK
Cancel

Click OK to begin the .NET Framework 4.0 Client Profile software install or click on CANCEL to stop installing SmartSDR for Windows.

If you choose not to install SmartSDR for Windows in order to install the .NET Framework 4.0 Client Profile, the following screen will be displayed.


Setup PreInstall Questions - SmartSDR v1.0.0
The .NET Framework 4.0 Client Profile setup program can be downloaded from the Internet.
A web browser will be opened automatically and load the URL where you can download the .NET Framework 4.0 Client Profile setup program. Once the download has completed, run the file dotNetFx40_Client_setup.exe to install the .NET Framework 4.0 Client Profile on your PC.
After the install of the .NET Framework 4.0 Client Profile has completed, click on the link "Windows Update" that is displayed after the text "Check for more recent versions" to install all necessary updates. Make sure you select all .NET Framework 4 updates from *both* the High Priority and Software, Optional sections before running the SmartSDR v1.0.0 setup program again.
OK
Cancel

Click on OK to open a web browser and download the .NET Framework 4.0 Client Profile software from the Internet or click on CANCEL to stop installing SmartSDR for Windows.

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4.3.2 Step 2. Installing SmartSDR for Windows

The first screen displayed is the Welcome to the SmartSDR Setup Wizard as shown below.

Setup - SmartSDR
Welcome to the SmartSDR Setup Wizard
This will install SmartSDR v1.0.0 on your computer.
It is recommended that you close all other applications before continuing.
Click Next to continue, or Cancel to exit Setup.
FlexRadio Systems
Next >
Cancel

Click NEXT to continue.

The SmartSDR for Windows End User's License Agreement screen is displayed as shown below.

Setup - SmartSDR
License Agreement
Please read the following important information before continuing.
Please read the following License Agreement. You must accept the terms of this agreement before continuing with the installation.
SmartSDR™ for Windows End User License Agreement
Revised: January 26, 2013
This copy of SmartSDR for Windows ("the Software Product") and accompanying documentation is licensed and not sold. The
I accept the agreement
I do not accept the agreement
SmartSDR v1.0.0 : FlexRadio Systems © 2012-2013
< Back
Next >
Cancel

To accept the license agreement, click on the "I accept the agreement" radio button and then click NEXT.

The Select Destination Location screen is displayed as shown below. It is recommended that you use the default installation location, as it will use the Windows recommended location for the application files. You may however choose an alternate location.

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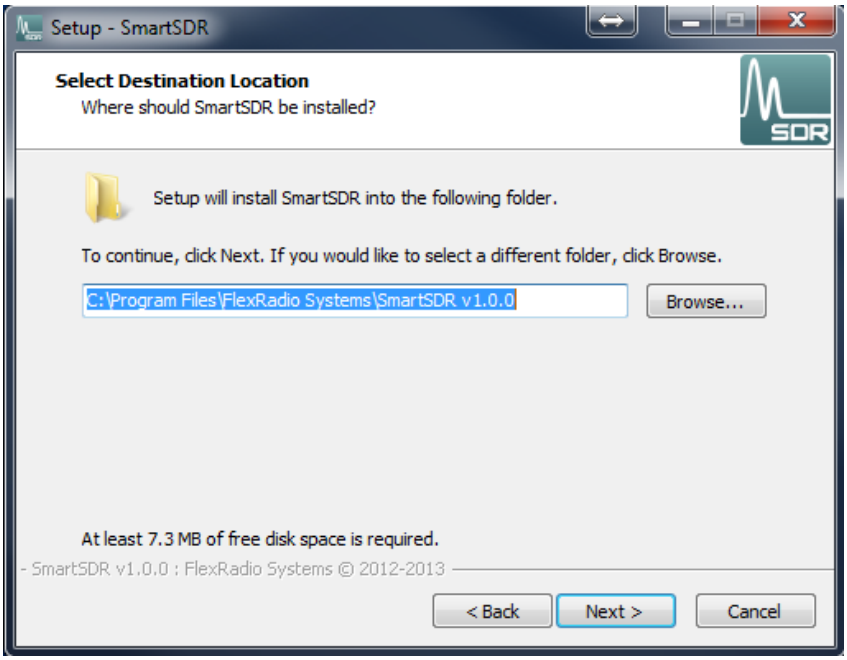
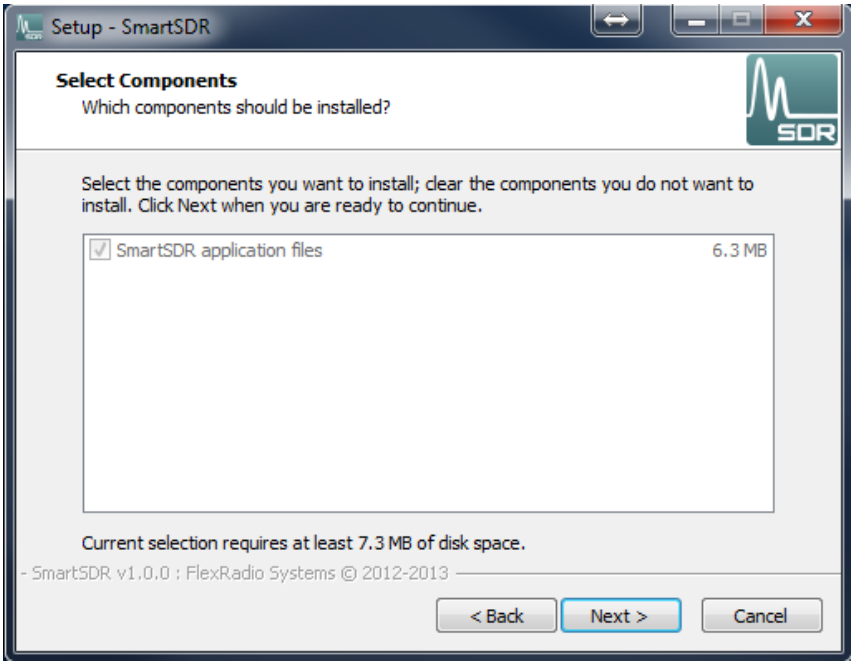

Setup - SmartSDR
Select Destination Location
Where should SmartSDR be installed?
Setup will install SmartSDR into the following folder.
To continue, click Next. If you would like to select a different folder, click Browse.
C:\Program Files\FlexRadio Systems\SmartSDR v1.0.0
Browse...
At least 7.3 MB of free disk space is required.
- SmartSDR v1.0.0 : FlexRadio Systems © 2012-2013
< Back
Next >
Cancel

Once you have decided on the installation location for SmartSDR for Windows, click NEXT to continue.

The Select Components screen is displayed as shown below; additional components may be displayed.


Setup - SmartSDR
Select Components
Which components should be installed?
Select the components you want to install; clear the components you do not want to install. Click Next when you are ready to continue.
SmartSDR application files
6.3 MB
Current selection requires at least 7.3 MB of disk space.
- SmartSDR v1.0.0 : FlexRadio Systems © 2012-2013
< Back
Next >
Cancel

Click NEXT to continue.

The Select Additional Tasks screen is displayed as shown below. It is recommended that you leave the "Create a desktop icon" option checked to provide a convenient way of starting SmartSDR for Windows from your Windows Desktop.

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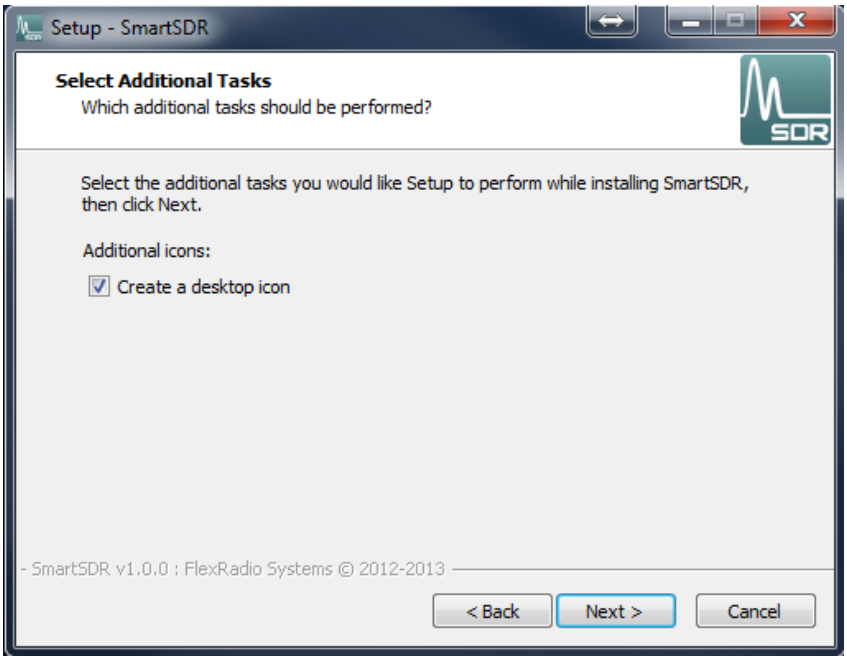
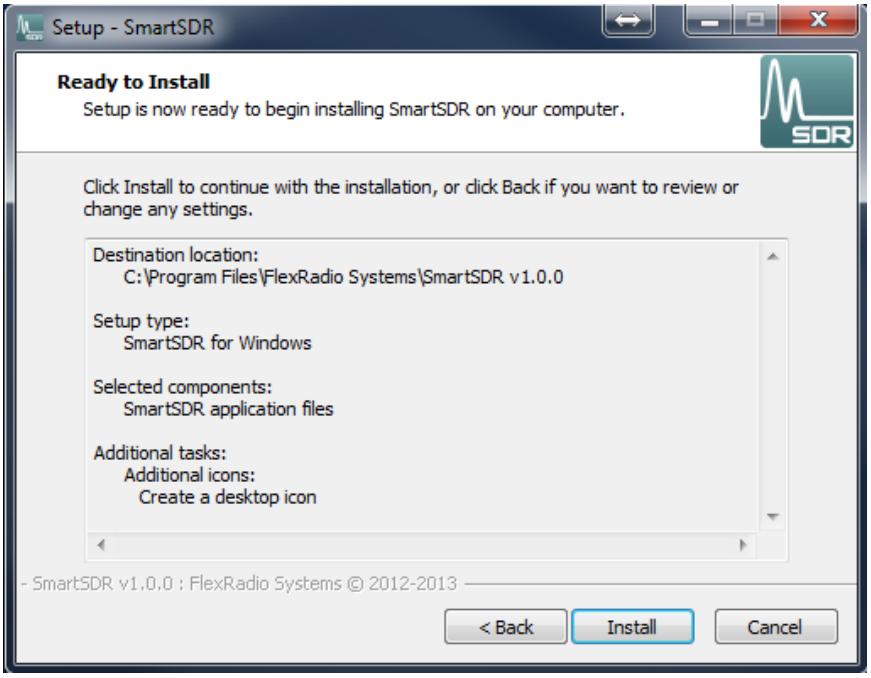

Setup - SmartSDR
Select Additional Tasks
Which additional tasks should be performed?
Select the additional tasks you would like Setup to perform while installing SmartSDR, then click Next.
Additional icons:
Create a desktop icon
- SmartSDR v1.0.0 : FlexRadio Systems © 2012-2013
< Back
Next >
Cancel

Click NEXT to continue.

The Ready to Install screen is displayed as shown below.


Setup - SmartSDR
Ready to Install
Setup is now ready to begin installing SmartSDR on your computer.
Click Install to continue with the installation, or click Back if you want to review or change any settings.
Destination location:
C:\Program Files\FlexRadio Systems\SmartSDR v1.0.0
Setup type:
SmartSDR for Windows
Selected components:
SmartSDR application files
Additional tasks:
Additional icons:
Create a desktop icon
- SmartSDR v1.0.0 : FlexRadio Systems © 2012-2013
< Back
Install
Cancel

Click NEXT to continue.

The Installing screen will be displayed showing the files being loaded

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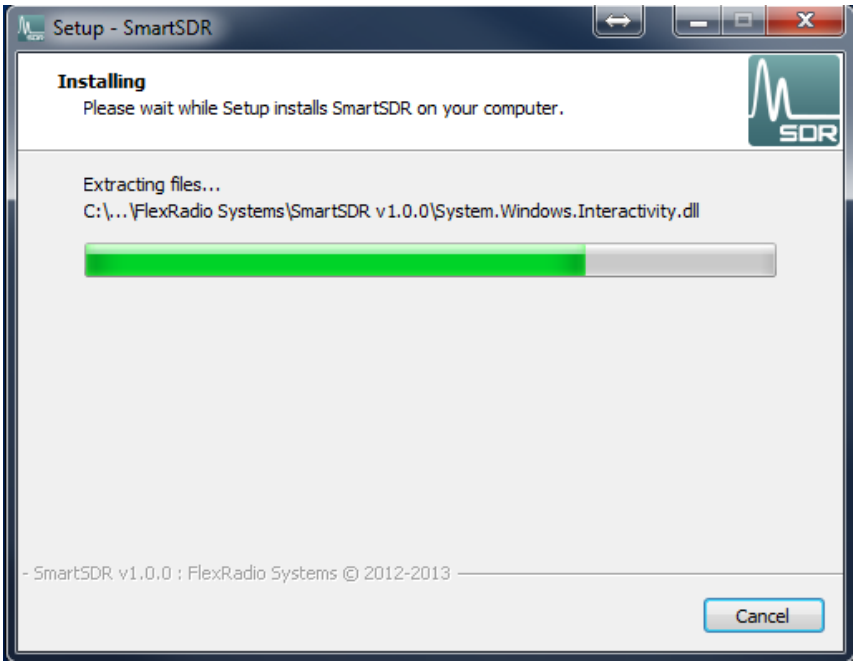
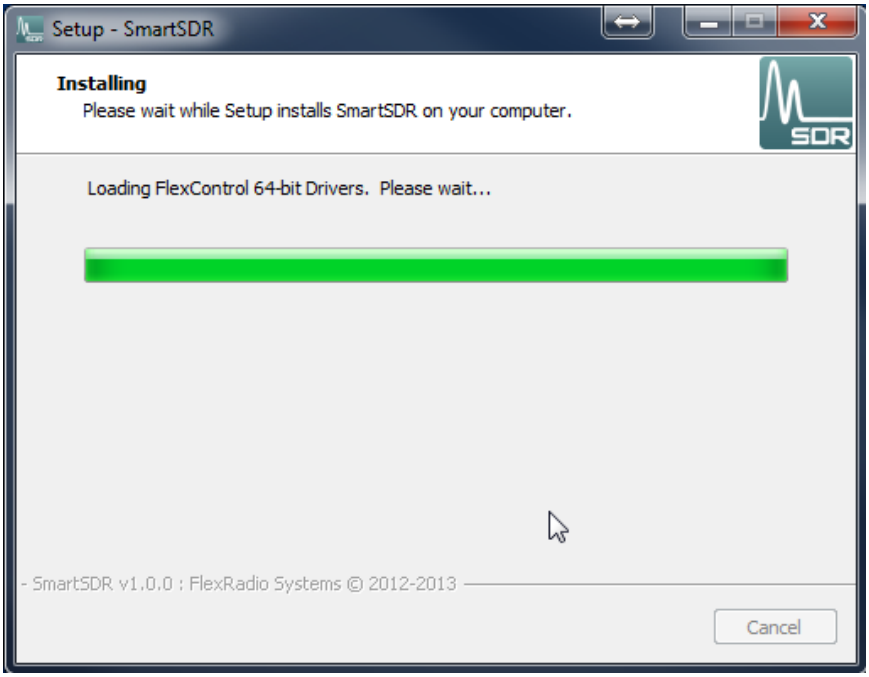


After the Files have been installed, additional drivers will be installed as shown below.


Setup - SmartSDR
Installing
Please wait while Setup installs SmartSDR on your computer.
Loading FlexControl 64-bit Drivers. Please wait...
- SmartSDR v1.0.0 : FlexRadio Systems © 2012-2013
Cancel

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After a few moments, the Completing the SmartSDR Setup Wizard screen will be displayed as shown below. It is recommended that you review the SmartSDR for Windows release notes as they contain important information regarding the features and operation for this specific release of SmartSDR. Check the "View the Release Notes (requires a PDF reader)" option to display the SmartSDR for Windows Release Notes after SmartSDR installer has completed the software install.

If you want to start the SmartSDR for Windows application after the SmartSDR installer has completed, leave the "Launch SmartSDR" option checked.

Setup - SmartSDR
sMartSDR
FlexRadio Systems
Completing the SmartSDR Setup Wizard
Setup has finished installing SmartSDR on your computer. The application may be launched by selecting the installed icons.
Click Finish to exit Setup.
Launch SmartSDR
View the Release Notes (requires a PDF reader)
Finish

Click Finish when you have made your selections.

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5 SMARTSDR OVERVIEW

5.1 THEORY OF OPERATION

SmartSDR is a software system designed to run on radios such as the FLEX-6000 Signature Series. SmartSDR has been designed from the start to work on hardware platforms that perform wide-band sampling of the RF spectrum. How is wide-band sampling different from other radios?

In superheterodyne (also called "superhet" or "multiconversion") radio systems, a series of down-conversions using local oscillators is performed on the RF input ultimately resulting in a baseband signal. This signal is generally only a few kilohertz wide and is ready to be demodulated and presented to the operator in the form of audio. In a superheterodyne architecture, generally only a single receiver is available at a time and the receiver has limited bandwidth.

In a wide-band sampling radio, a large portion of the spectrum is sampled (turned into digital information) all at once. This sampling provides the basis to use a number of analysis tools and receivers in the spectrum all at once, all from the one hardware sampler. Because the notion of a receiver is firmly embedded in both the amateur community and possibly the rest of the world, it seemed inappropriate to describe the functionality of a wide-band sampling system simply as a "receiver."

5.2 KEY SMARTSDR COMPONENTS

5.2.1 Signal Capture Unit (SCU)

Instead, in the SmartSDR world there are one or more "Signal Capture Units" or SCUs that are responsible for the collection of wide-band data from the RF spectrum. The SCU components are: an antenna input, an optional set of receive preselectors, and an analog-to-digital converter (ADC). Each SCU in the radio system can be connected to only a single antenna at a time, but due to the sampling architecture it may support potentially any number of receivers and spectrum displays. The SCU enables listening to multiple bands at the same time on the same antenna. A hardware platform with multiple SCUs such as the FLEX-6700 allows for monitoring many bands of more than one antenna or the ability to perform more complex noise mitigation techniques that are available in multi-antenna systems.

5.2.2 Slice Receiver

SmartSDR can create a number of receivers out of the data collected from the SCU. How does this work? The SCU sampled data stream varies by radio, but is typically 1-4Gbps on data that contains all activity across a large section of the RF spectrum. In the FLEX-6700, for example, an SCU tuned to the HF band collects every signal present in the spectrum from 0-73MHZ! This data is not directly observable or understandable by an operator, so a number of tools exist for understanding and using the SCU data, the first of which is the Slice Receiver. Each Slice Receiver is tuned to a specific frequency just as a Variable Frequency Oscillator (VFO) would be in a traditional radio. The Slice Receiver then takes this more digestible amount of data (typically describing 10-20kHz of the band) and performs operations to output the signals required by the operator.

For example, in the case of a sideband receiver, the Slice Receiver will demodulate the upper sideband of the data collected, will filter it according to the receiver filter settings, may perform noise mitigation techniques on the data and then ultimately passes it to an audio system to become sound to the operator. Because the source of the Slice Receiver data is always the SCU data and each Slice Receiver uses the same techniques to demodulate, filter and convert the signal into audio, each Slice Receiver shares the same base performance as the other slice receivers. For the operator, this means that access to two or more receivers with the same top performance may be used interchangeably without concern for differing performance characteristics of each receiver often found in superheterodyne receivers.

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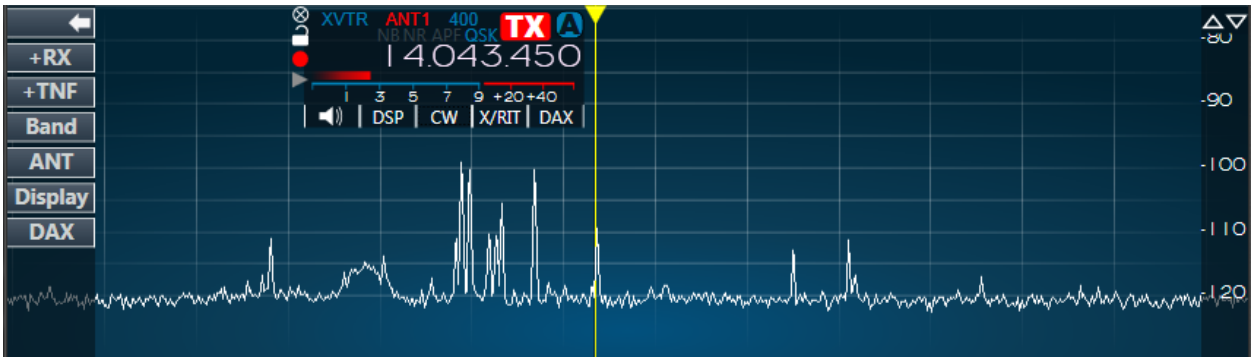
5.2.3 Panadapter

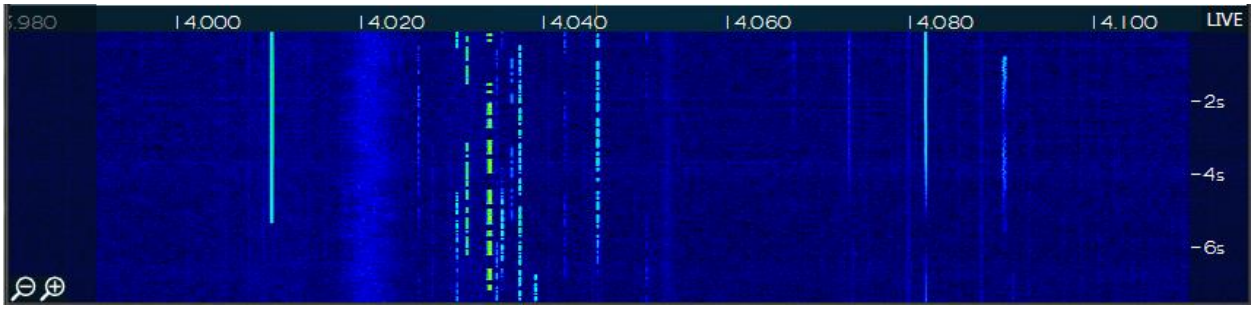
The panadapter uses the data available from the SCU and turns it into a visual representation of the spectrum instead of audio information. The panadapter display, pictured below, shows the level of signals present across a specific region of the spectrum just as a spectrum analyzer would. The higher the white line appears in the display, the stronger the signal is in that part of the band. A scale for the absolute signal level in dBm (decibels above or below one milliwatt) is provided on the right hand side of the display. This allows the operator to quickly identify signals of interest where the operator can focus his efforts.

Each panadapter is derived from the data from a single SCU so it is possible in multiple-SCU radios to show two different panadapters tuned to the same region of the spectrum, each with data from a different SCU and ultimately a different antenna. The panadapter shows the most current state of the spectrum and can be adjusted to show various widths of spectrum. A panadapter can be seen below.



5.2.4 Waterfall

The waterfall uses the same data from the SCU as the panadapter and turns it into a time-based visual representation of the spectrum. In the waterfall, intensity of signal is represented by a change in color in a similar way as water density is shown in a weather radar. The vertical position in the waterfall represents the time that the information on the spectrum was obtained. The waterfall owes its name to the way that it continually moved downward like a waterfall as time passes. The waterfall can be useful for understanding how signals are distributed in the spectrum over time, locating where stations have recently transmitted and even locating "holes" where operation will not interfere with other stations. A waterfall can be seen below:



5.2.5 Panafall

The panafall display is simply a panadapter and a waterfall that are joined such that the horizontal direction has the same frequency location. In this way, the panadapter portion of the display will show the current state of the spectrum and the waterfall portion will show a historical perspective.

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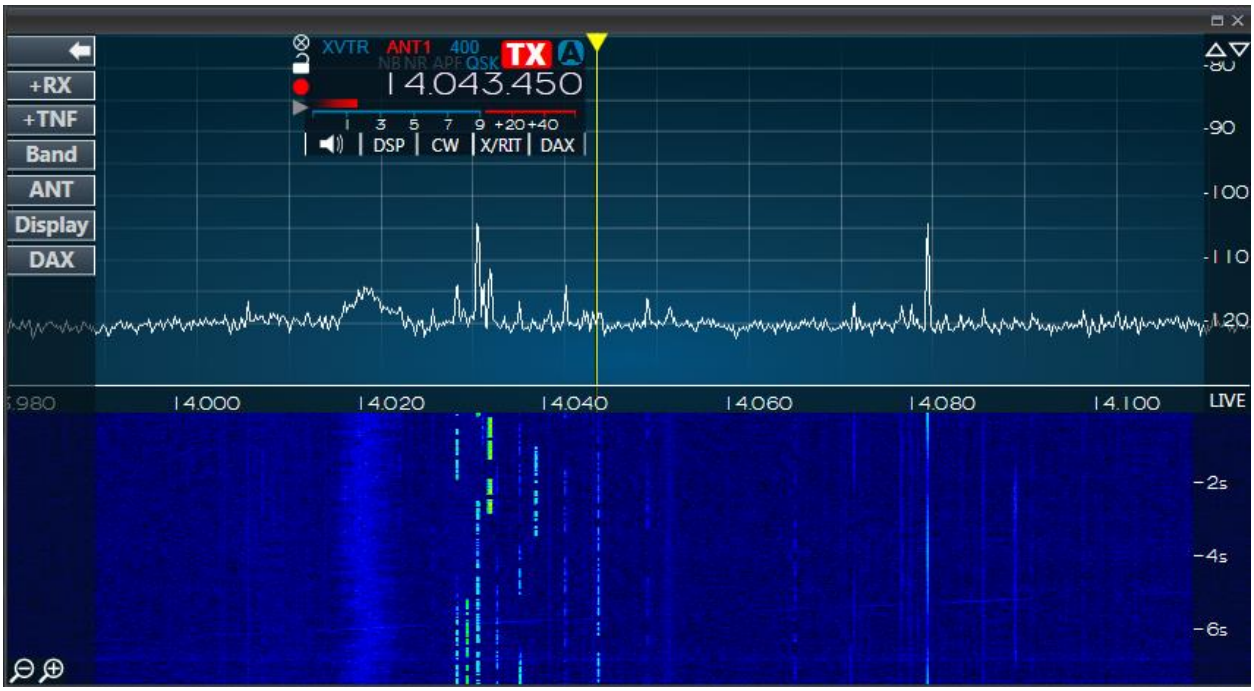

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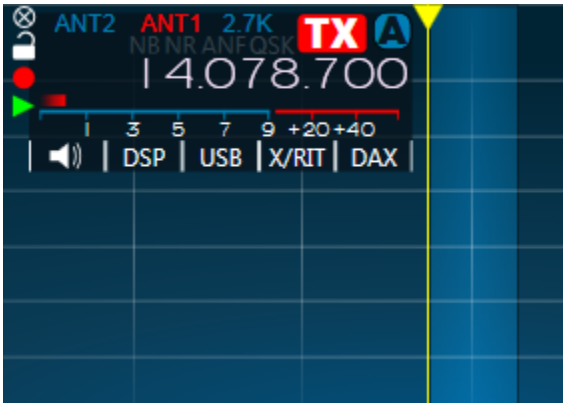
6 HOW TO OPERATE A SLICE RECEIVER

6.1 HOW TO CREATE AND DESTROY A SLICE RECEIVER

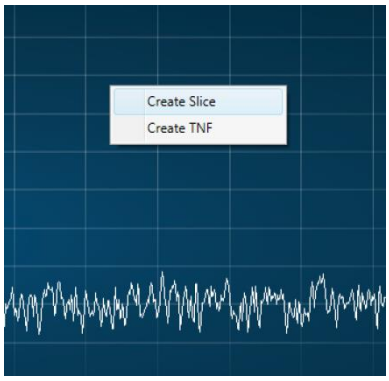
To add a Slice Receiver click the +RX button

on the left side of the panadapter. This action will place an additional Slice Receiver resource inside the corresponding panadapter. A Slice Receiver will be created in the center of the panadapter if none exist. If a Slice Receiver is already present in the panadapter, the new Slice Receiver will be created with the same basic characteristics (mode, DSP settings, etc.) as the active or closest Slice Receiver to the center of the panadapter with a mode specific frequency offset.



When you have utilized all of your available Slice Receiver resources, the Add Slice Receiver button will turn to a dark shade of grey indicating that the action is no longer available. It will return to an available state once a Slice Receiver is closed.

If your cursor is already in the position in the display where you would like to create a receiver, you may right-click the panadapter revealing a pop-up menu which will allow creation of a slice receiver at your current position.



When a Slice Receiver is within the bounds of a Panadapter, the Close Button will remove the slice from the panadapter and will no longer be accessible for receive or transmit audio.

If a slice has moved off screen outside the bounds of a Panadapter, the Slice Receiver display will change to indicate where the Slice is tuned relative to the Panadapter.

Double clicking on the indicator will center the slice in the panadapter. The

indicator also will show if the transmitter is enabled on the off screen slice.

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An Off-Screen slice can be closed by right-clicking on the off-screen indicator and selecting "Close Slice" or move it on screen by selecting "Move Slice here" as shown below:

If a Slice Receiver moves too far beyond the bounds of the Panadapter, it will be put into a detached state and will no longer produce audio. Moving the Slice back into the bounds of the Panadapter will put the Slice Receiver back into a normal state which produces audio.

6.2 HOW TO TUNE A SLICE RECEIVER

Drag Tuning is one of the more common tuning methods. By placing the cursor over the Receive Filter (lighter blue area of the Slice Receiver) or the carrier (the vertical yellow or red line of the Slice Receiver), the cursor will change to a small hand icon. Clicking and dragging when the hand icon appears will change the frequency of the Slice up or down in frequency as the panadapter remains stationary. This tuning will occur in increments of the currently selected step size. Once the Slice reaches the edge of the panadapter the Slice will stop and the panadapter will begin to move behind the slice. This is called Pan Edge Tuning and allows for rapid tuning above or below the panadapters current frequency range.

Double clicking anywhere in the panadapter grid will initiate a Click Tune. Click tune will move the active or closest Slice to the frequency where the mouse pointer is located.

Mouse Wheel Tuning occurs when an active slice is selected and the mouse is focused on, and within the boundaries of, SmartSDR.

FlexControl tuning will tune the active slice regardless of the mouse focus.

The amount of frequency changed by one tuning action on the FlexControl, Mouse scroll wheel or by dragging is determined by the active slice Tune Step size. Tune Step size is mode group specific and can be set by the user using the step size adjustment on the Active Slice Widget.

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6.3 MAKING A SLICE RECEIVER ACTIVE

A slice consists of a center Carrier Frequency displayed by a solid yellow or red vertical bar. A yellow bar indicates the slice is "Active," indicating that this is the slice that you are currently manipulating. An active slice will have the focus of tuning devices such as the mouse wheel and the FlexControl. You can toggle the active slice by clicking anywhere on an available slice's filter display. When a new Slice Receiver is selected as the Active Slice, the old Active Slice Receiver will become inactive and its carrier line will change to the red color. There can only be one Active Slice under tuning device control at a time in SmartSDR.

6.4 HOW TO CHANGE THE DEMODULATION MODE

The Mode Menu button on the Slice Flag displays the mode that is currently selected. Inside the menu there is a Mode drop down menu and three quick select modes. To change the quick select modes to a different mode, use a right click to expose a dropdown menu of available modes. Beneath the mode select buttons are the mode specific Filter Presets.

The position of the Receive Filter relative to the Carrier Frequency will correspond to what mode that you are in. A Receive Filter to the right of the Carrier indicates an Upper Sideband mode. A Receive Filter to the left indicates a Lower Sideband mode. A Receive Filter that spans both the left and right of the Carrier will indicate a double sideband mode.

6.5 HOW TO ADJUST THE SPEAKER AND HEADPHONE VOLUME OF A SLICE RECEIVER

Clicking on the Slice Audio menu button will expose the Slice specific audio controls. Right clicking on the Slice Audio menu button offers a shortcut for muting audio without having to enter the menu. The Slice Audio Menu includes a Mute button and volume slider to adjust the audio level of the slice. A Left and Right balance button and slider to adjust the balance between left and right channels for headsets or speakers. Automatic Gain Control (AGC) dropdown menu allows the user to select Fast, Medium, Slow and Off AGC settings. Finally, the slider to the right of the AGC dropdown controls AGC Threshold.

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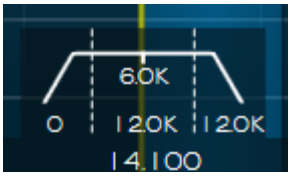
6.6 HOW TO CHANGE THE RX FILTER OF A SLICE RECEIVER

Surrounding the Carrier Frequency bar will be a blue Receive Filter bar which represents the filtered receive audio. The portion of spectrum that is highlighted by the Receive Filter bar will be output as audio.

The Receive Filter width can be adjusted manually by hovering the mouse over the edge of the bar to get the <-> cursor. Clicking and dragging will expand or reduce the size of the filter.



The Filter Control Widget is used to adjust the high cut and low cut of the Receive Filter. To initiate the Filter Control Widget, hover your mouse over the Carrier Frequency just above the horizontal axis Frequency bar. This will cause the Filter Control Widget to appear. Within the control there are three sections separated by dotted lines.

If you hover your mouse over the left section a left Control arrow will appear. Clicking and dragging left or right will adjust the low cut of the filter and will display as the left side of the Receive Filter moving left or right. The measurement at the bottom displays the separation from the carrier frequency.

The center section adjusts both the high cut and low cut of the filter simultaneously. Hovering over the center section will display a four way arrow. Clicking and dragging up and down from within this section will decrease/increase the low cut while increasing the high cut of the filter effectively making the Receive Filter bar wider. Clicking and dragging left and right will move the Receive Filter bar left and right relative to the Carrier Frequency.

If you hover your mouse over the right section a right Control arrow will appear. Clicking and dragging left or right will adjust the high cut of the filter and will display as the right side of the Receive Filter moving left or right. The measurement at the bottom displays the separation from the carrier frequency.

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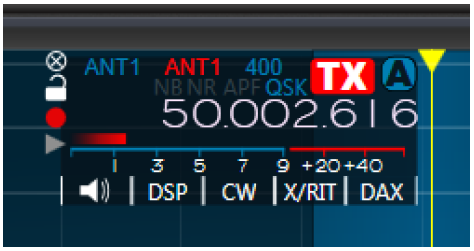
6.7 RECORDING AND PLAYING A SLICE RECEIVER

Slice receivers may be recorded using the Quick Record/Playback feature of SmartSDR. To the left of each slice receiver flag are both a record (round) and play button (triangle).



On initial startup, there is no recorded audio in the playback buffer and so the play button will be disabled (greyed out). To record audio from the slice receiver, press the record button once (circle). While recording, the record button will animate a repeated pulse.

Recording will continue until the record button is pressed again or until two minutes have passed. Recording will include any received audio while in receive mode and also any transmit audio when the radio switches to transmit mode. Once the recording is stopped, the record button will return to a solid red circle and the play button will be active (Green triangle):

To playback the audio, press the play button (triangle). If the play button is pressed while the radio is in receive, the playback audio will be routed to the speakers and headphones. If play is pressed while the radio is in transmit, the audio recording will also play through the transmitter.

To stop playing audio, press the play button a second time or wait for the recorded audio to finish playing.

To record or play again, press the appropriate button. Only one audio recording per slice receiver is saved. The audio played during transmit will originate in any playback regardless of whether the slice receiver the recorded the audio is the slice receiver now transmitting. For example, you may record audio using slice receiver A and then playback that audio over the air using slice receiver B. To do this, make slice receiver B the transmitter by selecting it using the red TX selection to the left of the letter B. Then press PTT on the microphone, footswitch or other PTT source and then press the play button on slice receiver A.

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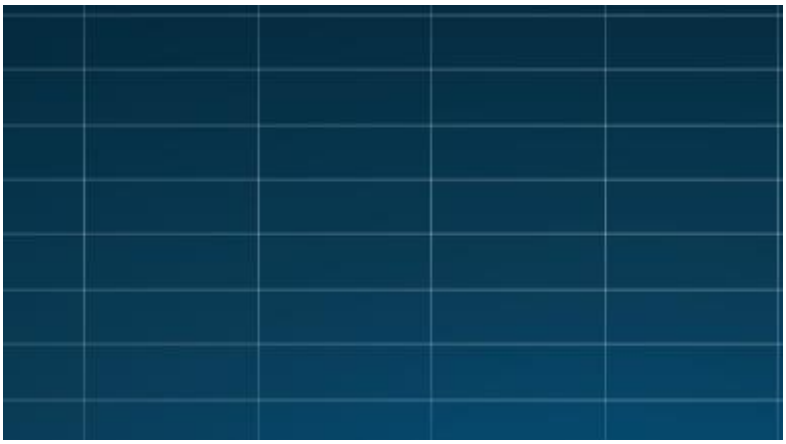
7 HOW TO OPERATE THE PANADAPTER/WATERFALL

7.1 HOW TO CREATE/DESTROY A PANADAPTER/WATERFALL

On the lower tool bar of SmartSDR there is a button to create a new Panadapter and Waterfall . This control will add another Panadapter to the Main Window. This control will turn to a dark shade of grey when you have used up the available panadapter resources.

Clicking the Close button will remove the panadapter and any slices that are displayed in the panadapter. Once this occurs you will not be able to use the slice resources until they are recreated in a new panadapter.

7.2 HOW TO CHANGE THE PANADAPTER FREQUENCY (TUNE)



Each panadapter has the ability to perform a pan function to adjust the frequency range that is viewed. Clicking and dragging within the panadapter grid will reorient the frequencies being viewed on the panadapter in the direction that your mouse is moving. By moving your mouse to the right you will display lower frequencies and vice-versa.

The Band menu button

in the Panadapter menu will expose the Band Menu. Selecting a band from this list will adjust the panadapter display to within the correlating amateur radio band. One band can be selected at a time and allows for rapid switching between views of the amateur radio bands. Clicking the Band menu button again will collapse the menu. Clicking on the XVTR button in the lower right will swap the buttons over to a list of XVTR bands. Click the HF button (same location) to swap back.

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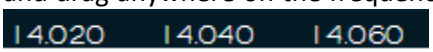
When switching between bands, if any Slice Receivers were left on the old frequency, these are removed and one new one will be added. If no Slice Receivers were present, one will not be added at the new frequency.

7.3 HOW TO ZOOM A PANADAPTER

Each panadapter has a zoom range up to a maximum of 14 MHz for the FLEX-6500 and FLEX-6700 or 7 MHz for the FLEX-6300 down to a minimum of 1.5kHz in bandwidth for the FLEX-6700 and 6kHz in bandwidth for the FLEX-6500 and FLEX-6300. There are multiple methods for adjusting the zoom of the panadapter.

The first is by the plus and minus buttons located in the bottom left corner of the panadapter and is used for rapid zooming. Zooming out (-) will double the bandwidth presented in the panadapter while zooming in (+) will cut the bandwidth in half. The frequency at the center of the panadapter will remain the same after clicking a zoom button.

The second method is a click and drag method using the horizontal axis for more precise zooming. Click and drag anywhere on the frequency labels located at the bottom of the panadapter to zoom in or out. 

The click and drag method will zoom in by dragging to the right and vice-versa. With this method the frequency at the point where your mouse was located at the click event will remain stationary in the panadapter.

When zooming out with a FLEX-6000 radio there are certain points where the size of the data used to create the display on the screen will need to be doubled. As this occurs there will be more noise taken into account while processing the display which will cause a noticeable increase in the noise floor. The reverse occurs when zooming in on a panadapter. After zooming out to a certain point, the hardware will switch to wideband mode. When this occurs, any panadapters that are affected by this change will display

in the top right corner to indicate that it is in wideband mode. When in Wideband the radio will open up the Bandpass Filters as wide as they can go for any panadapters or slice receivers that are using that Antenna. Note that the FLEX-6300 is always in WIDE mode and will not show this indicator.

Just to the left of the WIDE indicator is a spot for indicating whether the preamplifier is active and at what level. This indicator will normally be hidden. See section 24.1 for a complete description of preamplifier control.

One more step to the left is a spot for indicating whether the Panadapter is on a Transverter (XVTR) band. This indicator will normally be hidden. See section 22 for a complete description of how to setup for XVTR operation.

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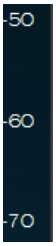
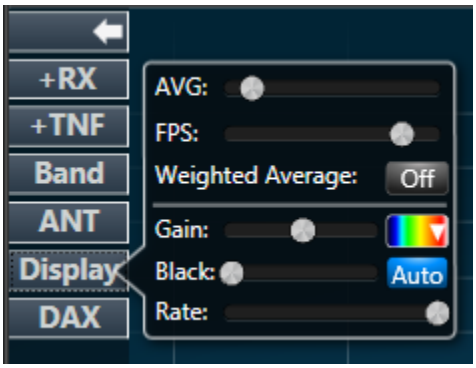
7.4 HOW TO CHANGE THE SIGNAL MAGNITUDE SCALE OF A PANADAPTER

Each panadapter will allow you to adjust the maximum and minimum amplitude displayed. Clicking the up or down arrows displayed in the top right corner of the panadapter will increase or decrease respectively the maximum amplitude displayed in 10 dB increments. You may also adjust the minimum amplitude by clicking and dragging the vertical axis. This will effectively adjust where the noise floor is positioned within the panadapter.



7.5 ADJUSTING THE PANADAPTER AND WATERFALL CONTROLS

Display menu button on the Panadapter menu will expose display controls. A horizontal line separates panadapter controls (top) from waterfall controls (bottom).



The FPS slider controls the Frames Per Second that the Frequency Line is drawn at. Lowering the FPS control has several effects:

- It lowers the rate at which both the panadapter and the waterfall are updated
- It lowers the network bandwidth of data sent from the radio to the client (important in situations where you may have limited bandwidth)
- As the rate of update is lowered, the extra data not displayed is averaged and so the variance of the data is lowered, making both the panadapter and the waterfall smoother

If you prefer a faster updating display, but a more averaged or smoother one, adjust the FPS setting for the update speed you prefer and then raise the AVG (averaging) control. The AVG control increases the number of frames that are averaged, lowering the variance and smoothing the display.

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The final panadapter control, Weighted Average, emphasizes signals that are increasing in amplitude over ones that are declining. This has a tendency to continue to show locations where signals have been and show a more precise view of their full amplitude when they first appear.

Below the line at the center of the control are the Waterfall controls.

The Gain, Black and Auto controls work together to adjust how different signal levels are displayed in the waterfall. The Black control sets the level below which all pixels will render as black. In other words, it sets the level at which signals are no longer of interest. The Auto control will automatically set the black level to just below the noise as band conditions, preamplifier changes or antenna changes alter the noise floor. To enable auto-black, click the Auto button so that it is blue.

The Gain control adjusts how rapidly the waterfall will advance through the color spectrum for minimal changes in signal level. Adjusting gain low gives the waterfall a broader dynamic range, but lessens its ability to show small variations signals. Raising the gain lowers the dynamic range, but provides more detail in the variances in smaller signals' magnitudes.

The rate control adjusts how fast the waterfall will advance on the screen. At the lowest setting, many minutes of data can be persisted on the display. On its highest setting, the waterfall displays a rapidly changing spectrum in the most detail.

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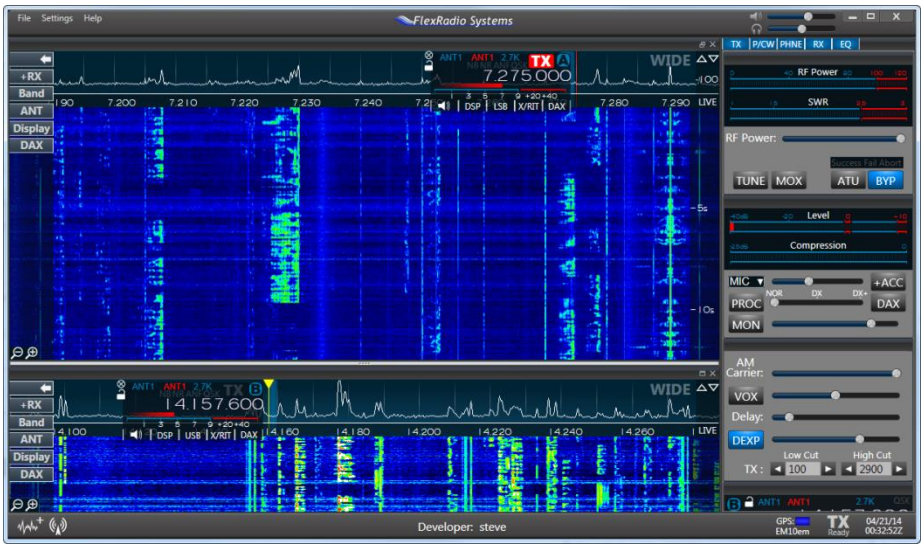
In most cases Auto Black properly adjusts the background color or black level for the display's zoom factor and the relative noise floor of the band you are viewing. You can however manually adjust the Waterfall display's setting to allow for the display of weak signals at or near the noise floor. If the black level is set too low, many of the "in the noise" FFT bins will always be zero, regardless of the display gain setting. To achieve and ideal setting for adjusting the waterfall black level, do the following:

- Turn the display gain level to maximum
- Adjust the waterfall black level to a point where the waterfall is primarily white, but there are approximately 2-5% black areas displayed.
- Turn the display gain down until the background is deep blue.

This ensures that small signals in the noise will be seen.

7.6 HOW TO CHANGE THE SIZE AND POSITION OF MULTIPLE PANADAPTERS

Clicking the Maximize button will prioritize the arrangement of the panadapter at the top of the display. Once a panadapter is maximized a grey horizontal separator will appear between the maximized panadapter and any other panadapters that are open at the time. Clicking and dragging this horizontal separator will increase or decrease the available size for the maximized panadapter. The non-maximized panadapters will adjust to fill the remaining available space. To return to the standard view click the next to the close button. You can have up to three maximized panadapters at a time.



When multiple panadapters are open, clicking on the main bar and dragging its position will rearrange the panadapter windows.

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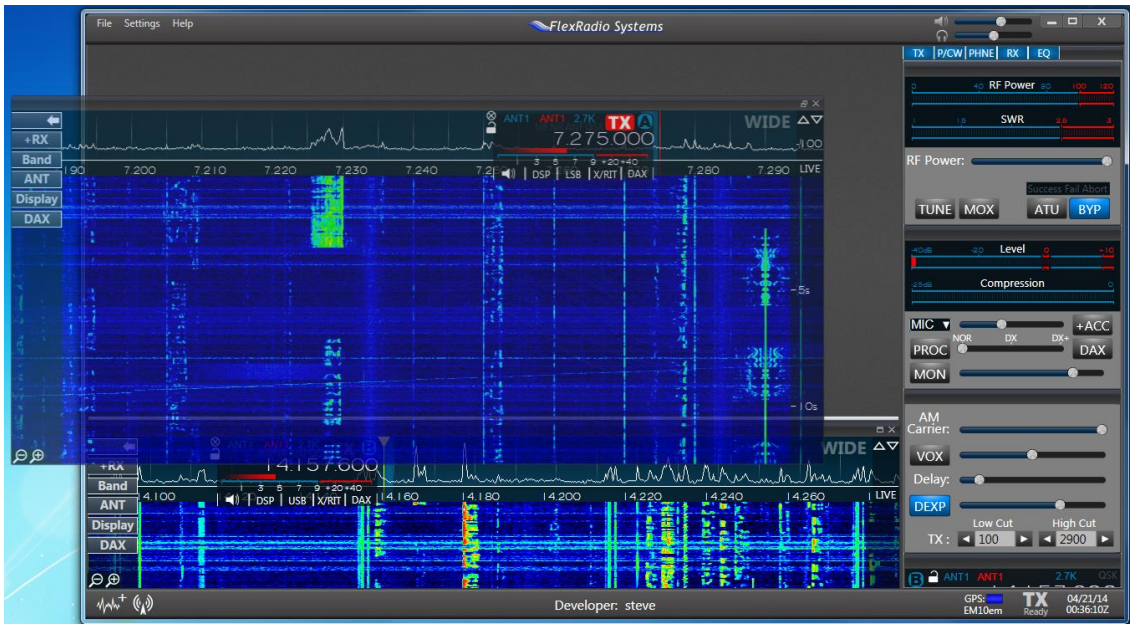

When multiple panadapters are open, clicking on the main bar and dragging its position will rearrange the panadapter windows.

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8 TRACKING NOTCH FILTERS

8.1 TRACKING NOTCH FILTER (TNF) THEORY

With notch filters found on most receivers, the notch is removing an audio frequency after the AGC. When you hear a carrier in the middle of a sideband transmission, you can enable the notch and adjust it to remove the objectionable carrier. This issue with this type of notch is apparent when the dial frequency is changed. Since the notch is on an audio frequency offset, as the dial frequency is changed the audio frequency of the undesirable frequency is changed and it falls out of the notch, requiring a readjustment of the notch.

With the Tracking Notch Filter™ (TNF), once the frequency has been notched the filter remembers the RF frequency of the objectionable signal. When the dial frequency is changed, the filter is automatically adjusted to maintain the notch on the objectionable frequency. With SmartSDR, you can have a large number of Tracking Notch Filters to notch out local problem carriers or birdies across all bands covered by SmartSDR. The TNFs may be temporary, for only the current session, or they may be remembered permanently.

8.2 CREATING AND ADJUSTING A TRACKING NOTCH FILTER (TNF)

To create a TNF, click the

button on the left side of the panadapter. This will create a TNF in the center of the panadapter. You can also right click in the panadapter or waterfall on the frequency where you would like the TNF created and select "Create TNF."

The Tracking Notch Filter will be created on the frequency where the right-click occurred. A TNF will be shown by a greenish vertical line with diagonal stripes.

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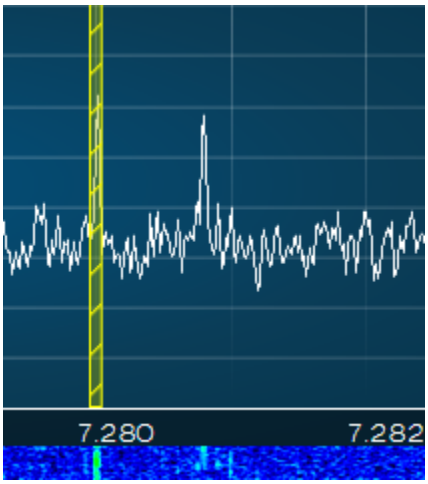
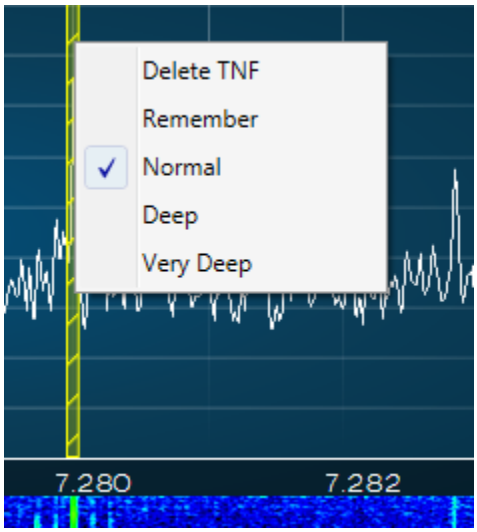
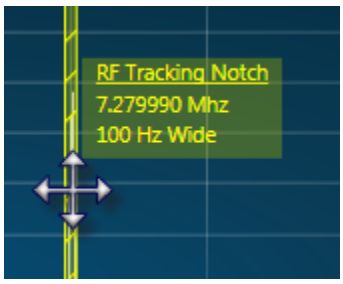


Once the TNF is created, the TNF may be remembered, deleted or additional notch depth may be added by right-clicking on the TNF again:



To see details on the current TNF or change its frequency or width, hover your cursor over the TNF. The cursor will change to a 4-way directional cursor and details about the TNF will appear in a callout:



To increase the width of the TNF, left-click and then move the cursor up-and-down. To adjust the frequency of the TNF, slice side-to-side.

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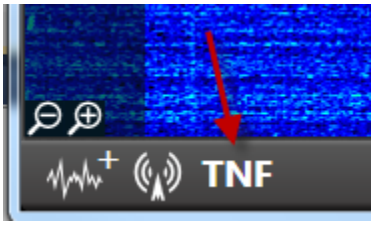
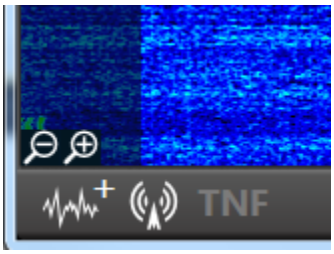
8.3 TURNING ON OR OFF ALL TRACKING NOTCH FILTERS (TNF)

To disable all TNFs at the same time, click on the TNF icon in the bar at the bottom on SmartSDR:



When all TNFs are disabled, the TNF icon will "gray out" as shown below. To re-enable all TNFs, just click on the button again.



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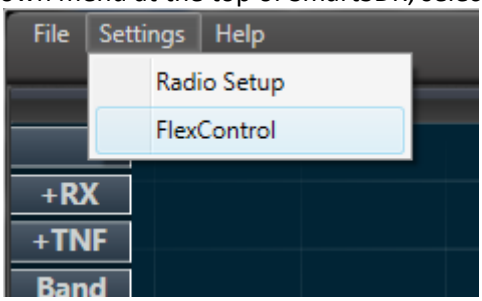
9 HOW TO REPROGRAM A FLEXCONTROL

From the "Settings" dropdown menu at the top of SmartSDR, select the "FlexControl" option.



This will bring up the simple mode FlexControl panel.

The panel resembles the physical appearance of the actual FlexControl to make the programming experience more intuitive. Each of the buttons have a corresponding drop down menu that allows the user to modify its function.

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The different options include:

- Tune Slice – When enabled the knob will tune the active slice
- RIT (Receive Incremental Tuning) – When enabled the knob will tune the RIT of the active slice. Double clicking the button will zero the RIT setting.
- XIT (Transmit Incremental Tuning) – When enabled the knob will tune the XIT of the active slice. Double clicking the button will zero the XIT setting.
- Slice AF – When enabled the knob will adjust the volume of the active slice
- Master AF – When enabled the knob will adjust the master volume control
- AGCT (Automatic Gain Control Threshold) – When enabled the knob will adjust the AGCT of the active slice.
- CWX Macros – When selected, pressing the button will send the selected CWX Macro
- None

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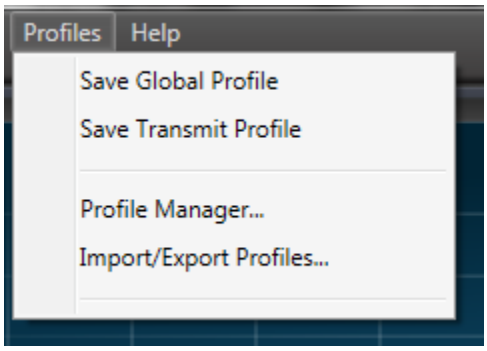
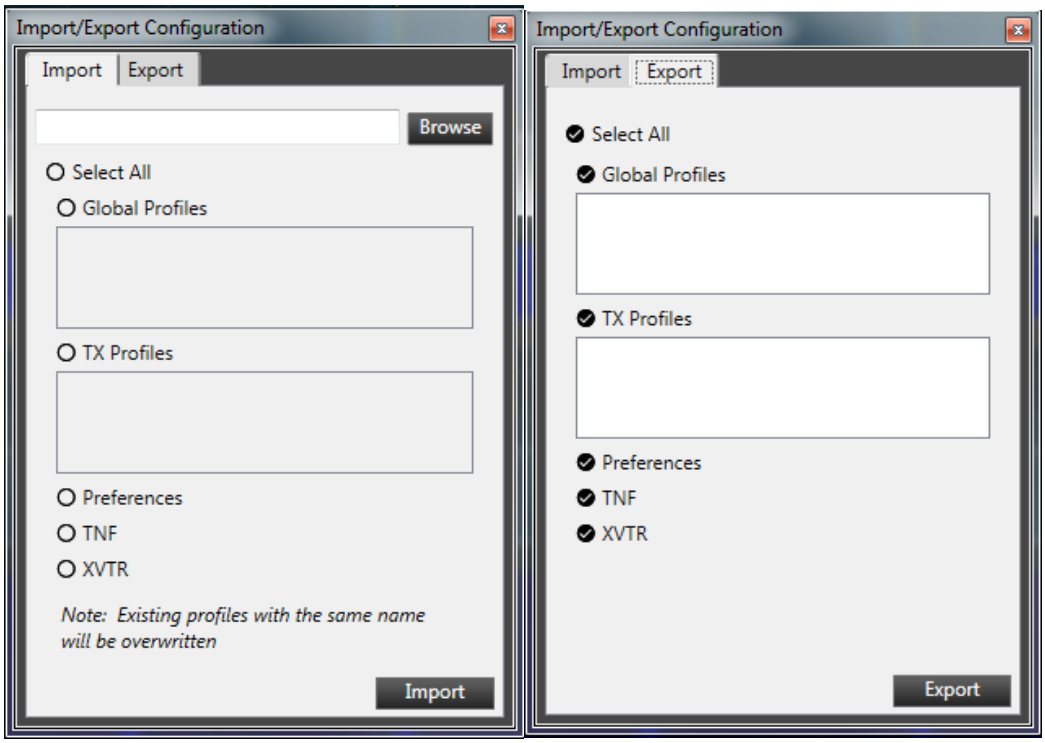
10 HOW TO IMPORT AND EXPORT RADIO SETTINGS

From the "Profiles" dropdown menu select "Import/Export Profiles"



This will bring up the Import/Export window:



Select the corresponding tab for import or export controls. The "Browse" button on the Import tab will bring up a Windows Explorer window that can be directed to the file being imported. The user can check the items that they wish to import/export by clicking on one of the circles ○ next to the setting. When selected a checkbox will display inside the circle ◉. Checking/unchecking the circle next to select all will select/deselect all the subsequent options. Click "Import" or "Export" to complete the process. Clicking "Export" will prompt the user to save the file to a specified location. NOTE: Exports will only contain profiles that the user set and will not include the default profiles built into SmartSDR.

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11 HOW TO SAVE AND CHANGE PROFILES

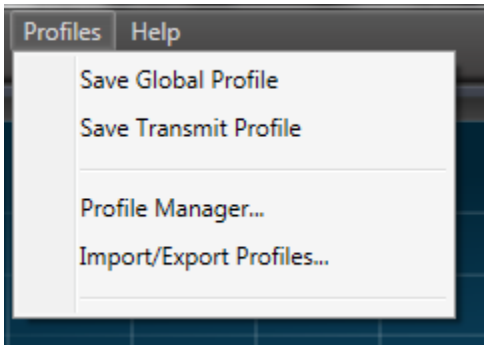
Profiles allow the user to name and save the entire state of the radio and recall it later. Profiles can even be exported and restored on another FLEX-6000 Series radio. This facilitates convenient backup and also helps IT managers at DXpeditions or contest super-stations test configurations and then install them or restore them at a site. Individual operators can also save their favorite settings and then after others have operated, restore the state of the radio to where it was. [Note: Graphical User Interface layout settings are not stored in v1.3 but may be included in a future version.]

There are two types of profiles: GLOBAL and TRANSMIT profiles. Global profiles store the state of the radio including the panadapters and slices that are open, the current modes and all of the settings for noise blanker, AGC, filters, etc. There are also transmit profiles that can be used to store a profile for a specific microphone or operating style.

Profiles are far superior to traditional "band stacking" in that you can save as many different configurations as desired and give them a meaningful name for recall. The user can leave the Profile Manager open to the side of the SmartSDR window and instantly switch configurations by double clicking the desired profile.

11.1 SAVING AND DELETING PROFILES

From the "Profiles" dropdown select the option "Save Global Profile" or "Save Transmit Profile"



This will bring up the Profile Manager Window

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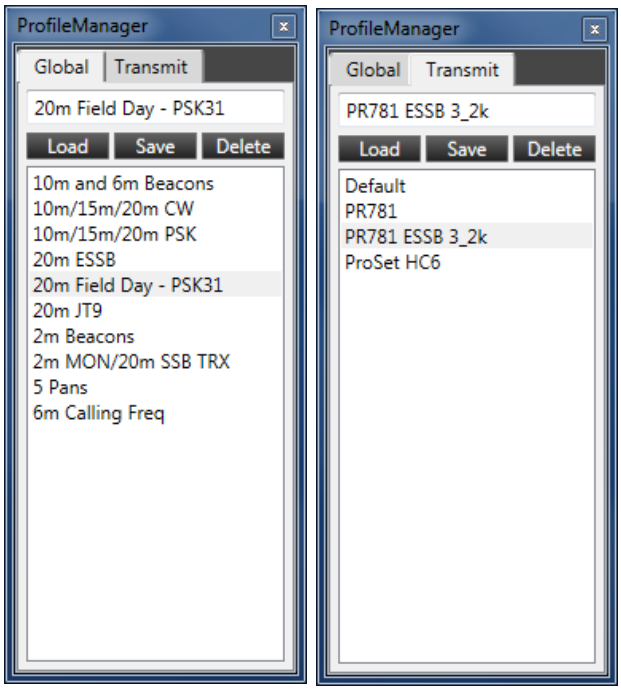

There are two tabs at the top of the window and the tab that is selected will correspond to which menu option the user selected. Type the desired profile name into the text box at the top that says "New Profile Name" and click save or hit the Enter key on the keyboard to save a new profile. Saving a Global profile will save all of the current settings for the radio. Saving a Transmit profile will save only the settings related to transmit.

To delete the profile, select the profile name and click the delete button.

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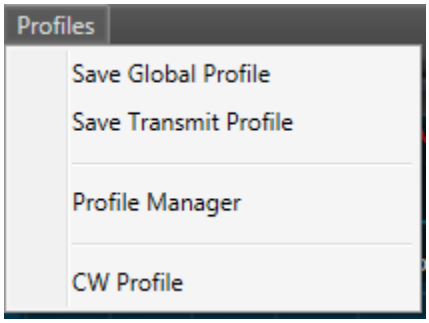
11.2 LOADING PROFILES

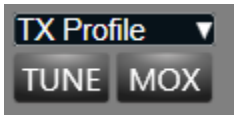
To load a profile from the Profile Manager Window, select the desired profile and click load or just double click on the profile name.

After a profile is saved a quick selection option becomes available on the Profiles drop down menu to rapidly change between saved profiles.

Global profiles can quickly be changed from the "Profiles" dropdown menu. The saved profiles will show up under the "Profile Manager" selection.



Different Transmit profiles can quickly be selected from the dropdown menu on Transmit Panel above the "Tune" and "MOX" button.



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12 HOW TO OPEN AND CLOSE THE TRANSMIT CONTROL PANEL

To display the Transmit Control Panel click on the Transmit Control Panel icon, shown below, in the lower left hand corner of the SmartSDR application window. Clicking the icon again will remove the Transmit Control Panel

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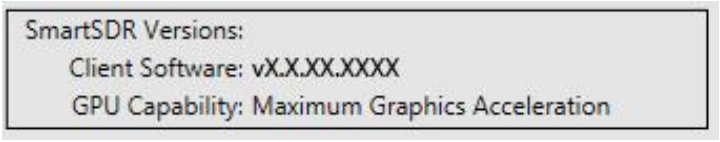
13 HOW TO DETERMINE THE IP ADDRESS OF THE RADIO AND THE SOFTWARE VERSION NUMBERS

Bring up the Radio Setup Panel by clicking the "Settings" dropdown menu at the top left of SmartSDR. Then select "Radio Setup".

Located in the "Radio" tab is basic information about the selected radio. Radio Hardware version refers to the software and firmware that is loaded into the radio itself.

Located in the "Startup" tab is information about the client. Client Software refers to the software that runs on your computer to operate the radio.



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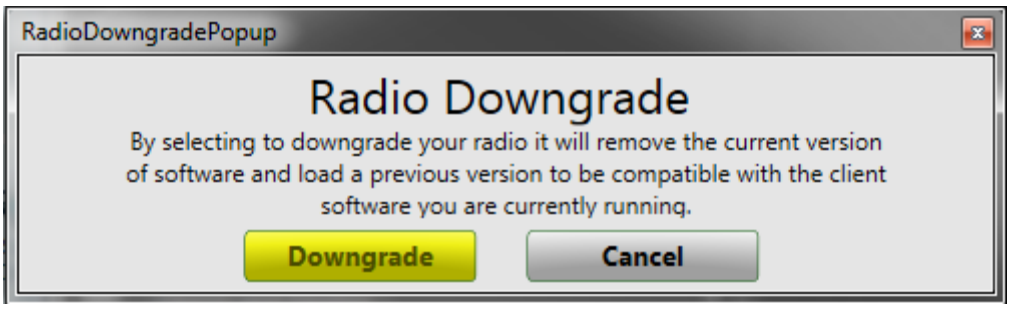
14 HOW TO GET TECHNICAL SUPPORT AND ASSISTANCE

You can get technical support by opening a HelpDesk support ticket (helpdesk.flexradio.com) or by calling at 512-535-4713 x2.

Another great resource is our online community (community.flexradio.com) where FlexRadio Staff and other FlexRadio Operators post Ideas, Questions, Praises, Problems and solutions. The community has powerful search capabilities that allow you to easily locate solutions to questions that others have previously asked.

15 HOW TO UPDATE THE SOFTWARE

In the event where the current Radio Hardware version is not compatible with the current Client Software version, an update will be required. You will notice that there is a yellow indicator Update followed by the text "Update" in the list box where your radio is listed. You will also notice text requiring you to update your radio before you can proceed. In order to resolve the discrepancy, click Update. As long as your radio is advancing to a more recent revision it will begin the update process. If the Client Software requires an older Radio Hardware version, a pop up window will be shown to ensure that this is being done intentionally.


RadioDowngradePopup
Radio Downgrade
By selecting to downgrade your radio it will remove the current version of software and load a previous version to be compatible with the client software you are currently running.
Downgrade
Cancel

Clicking the Downgrade button will remove the current version of software and load a previous older version to be compatible with the client software you are currently running. Click Downgrade to proceed. Click Cancel to maintain the existing version of Radio Hardware. (Note: If you were not intending to downgrade the radio, check to make sure that you are running the correct version of SmartSDR.)

Once the process has started you will see a progress bar showing the approximate completion status. Upon completion of the update you will see Available appear next to the radio in the list box.

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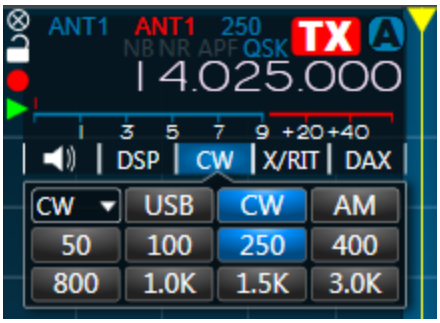
16 HOW TO OPERATE CW



To use SmartSDR in CW mode, select CW in the slice control panel. This will automatically bring up the CW specific controls in the transmit panel, and show the narrower CW receive filter presets.

The CW display is slightly different from the SSB display. In CW mode, the slice carrier indicator line is in the center of the receiver passband. This coincides with the CW carrier frequency, and takes into account the CW pitch offset. It shows exactly the location of your transmitted carrier.

16.1 HOW TO OPERATE CW IN SPLIT MODE

Many DXpeditions prefer to operate split mode, where they transmit on a frequency, but listen up or down a few kilohertz. In order to do this in SmartSDR, you must add a second slice receiver to the panadapter to use as your secondary frequency. To add a slice, click the

button on the left side of the screen. Your panadapter display should look like this:

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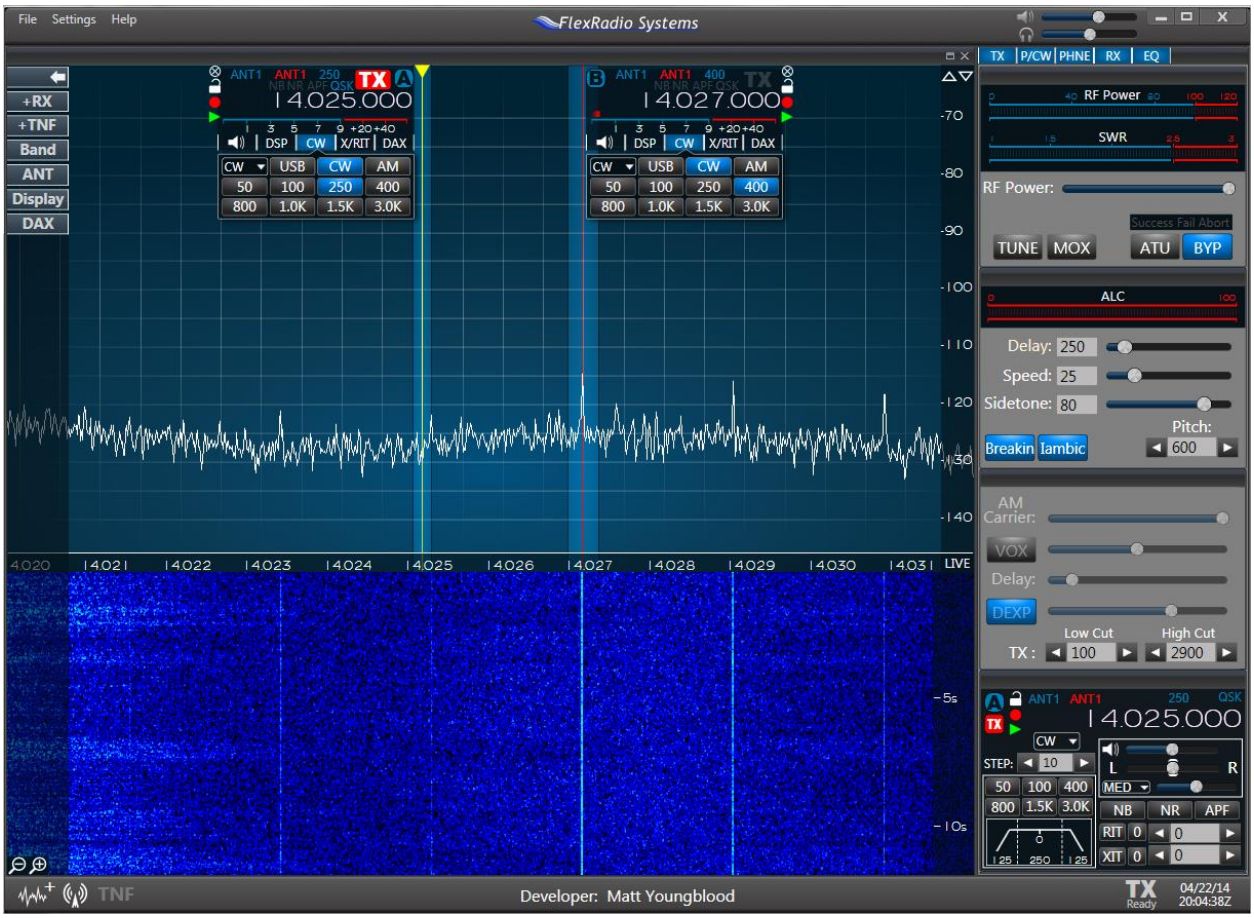
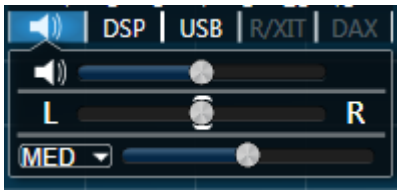


Slice receiver A should be tuned to the DX station's transmitting frequency. Slice receiver B should be selected as the active slice so you can tune your transmit frequency to where the DX station is listening. Select TX enable on slice B so your transmitter will follow.



If you prefer, you can use the slice audio controls to pan the slice audio so one receiver is in your left ear and the other is in your right ear.

16.2 CW TRANSMITTING

In order to transmit CW, you will need either a straight key, or an iambic paddle if you want to use the built-in keyer. Refer to the FLEX-6000 Hardware Reference Manual for wiring instructions.

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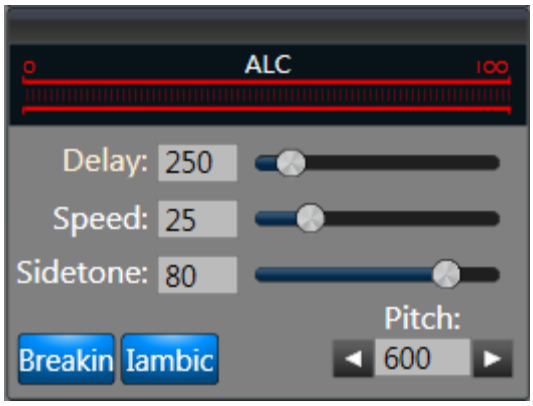

If you want to use a straight key, uncheck the IAMBIC control in the CW transmit panel. The BREAKIN control allows automatic PTT when the key is pressed. The Delay slider sets the PTT hold time for break-in in milliseconds. It can be set anywhere from zero (full QSK), to 2000 milliseconds (2-seconds).

16.3 USING THE BUILT-IN KEYER

The radio has a built-in iambic keyer that can be used either as iambic "A" or iambic "B". These settings are on the CW tab of the Radio Setup panel. It is also possible to swap the dot and dash paddles in software.

The keyer speed can be set anywhere between 5 and 100 WPM using the Speed control in the CW transmit panel. The IAMBIC selector must be enabled to use the built-in keyer. The Sidetone control will increase or decrease the sidetone volume in the speakers and headphones.

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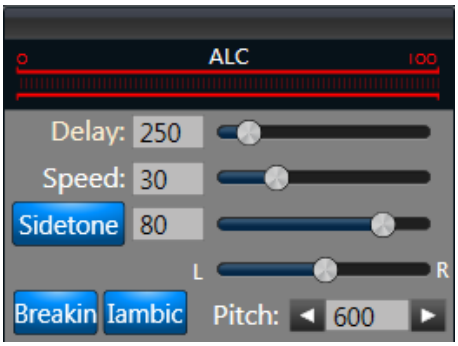

16.4 HOW TO OPERATE QRQ (HIGH SPEED) CW WITH QSK

The FLEX-6000 is capable of full QSK operation. In order to use QSK, the delay control must be set to zero. This will allow the transmit/receive switching to occur immediately upon release of the key. The FLEX-6000 uses very fast reed relays in the CW T/R switching, but at extremely high CW speeds, above 60 WPM, you will get better inter-element receiving results using one antenna for transmit and a different antenna for receive. Refer to the antenna selection instructions for information on how to configure separate transmit and receive antennas. (QRQ is only available on FLEX-6700)

16.5 HOW TO CONNECT AN EXTERNAL KEYER USING THE FSK/KEY INPUT ON THE REAR PANEL ACCESSORY CONNECTOR

In CW mode, the FSK/Key (Pin 4) input on the rear panel accessory connector can be used as a straight key input. This is useful if you wish to attach an external keyer, such as a K1EL WinKeyer, microHAM microKEYER, or other contest-oriented interface. This input is always active, and is not affected by the FLEX-6000 internal keyer settings. It's therefore possible to use both the external keyer, and the internal keyer at the same time.

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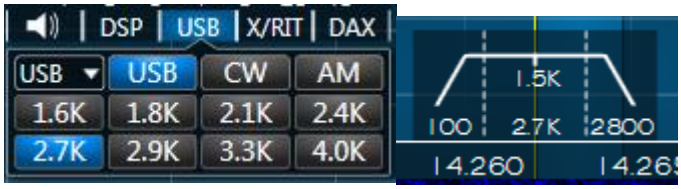
17 HOW TO OPERATE SINGLE SIDEBAND (SSB)

To use SmartSDR in SSB mode, select either USB or LSB in the slice mode select control panel. This will automatically bring up the SSB specific controls in the transmit panel, and show the wider receive filter presets. The image above shows the slice receiver in USB mode. USB and LSB are automatically selected for the normal mode of operation for each band when the band selection panel is used.

To select the opposite SSB mode, click on the mode indicator as shown above. In this example, LSB can then be selected from the drop down menu to the left of the USB indicator.

In SSB modes, the slice carrier indicator line will be located to the left of the receiver passband for USB and to the right for LSB. It shows exactly the location of your transmitted SSB suppressed carrier frequency. If the slice is the active slice, the carrier indicator line will be displayed in yellow and with a triangular arrow at the top. All other slices are displayed with no arrow and have red carrier indicators.

17.1 HOW TO SELECT THE SSB FILTER BANDWIDTH



Standard SSB filter bandwidths from 1.6K to 4.0K can be selected from the drop down panel under the mode selection button as shown below. Custom bandwidths can be adjusted either by clicking and

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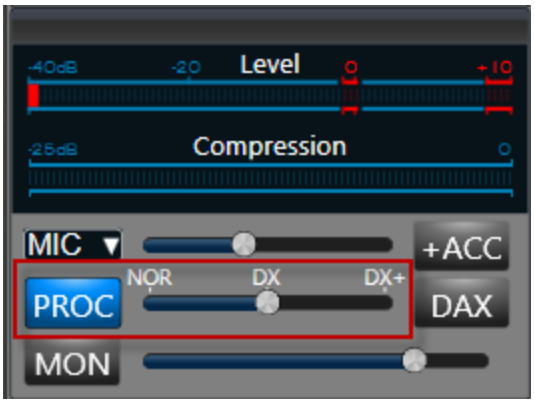
dragging the side of the filter display on the panadapter or by using the filter widget control enabled by hovering the mouse at the bottom of the carrier indicator.

17.2 OPERATING THE SPEECH PROCESSOR

The speech processor, shown below in the red square, may be on or off and has three different settings if turned on. In the NOR or normal setting, the processor provides minimal additional gain and simply prevents audio peaks from clipping or producing excess power (than what has been set). In the DX setting, more gain is provided to the audio to increase the overall sideband envelope which results in a stronger signal that may be more readily heard at a distance. The DX+ setting adds even more gain increasing your talk power or "punch" without incurring audio distortion. DX+ is most effective if you increase the low cut TX filter to between 200-400 Hz in order to concentrate your talk power in the audio frequency range that has the greatest intelligibility.



The recommended setting is to leave the speech processor enabled and in the NORmal position.

17.3 HOW TO OPERATE SSB IN SPLIT MODE

Many DXpeditions prefer to operate split mode, where they transmit on a frequency, but listen up or down a few kilohertz. In order to do this in SmartSDR, you must add a second slice receiver to the panadapter to use as your secondary frequency. To add a slice, click the

button on the left side of the screen. Your panadapter display should look like this:

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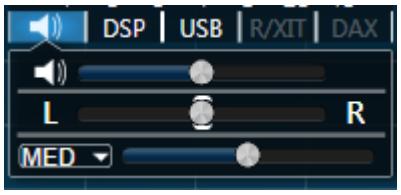
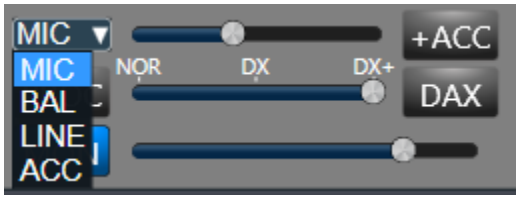
Slice receiver A should be tuned to the DX station's transmitting frequency. Slice receiver B should be selected as the active slice so you can tune your transmit frequency to where the DX station is listening. Click on TX on slice B so your transmitter will follow the active slice.



If you prefer, you can use the slice audio controls to pan the slice audio so one receiver is in your left ear and the other is in your right ear.

17.4 HOW TO CONFIGURE YOUR AUDIO CONTROLS FOR VOICE MODES



Connect a suitable microphone to the 8-pin front panel connector or to the balanced microphone input following the instructions provided in the FLEX-6000 Hardware Reference Manual. In the transmitter control panel, select "MIC" for the front panel microphone or "BAL" for the rear panel balanced microphone input.

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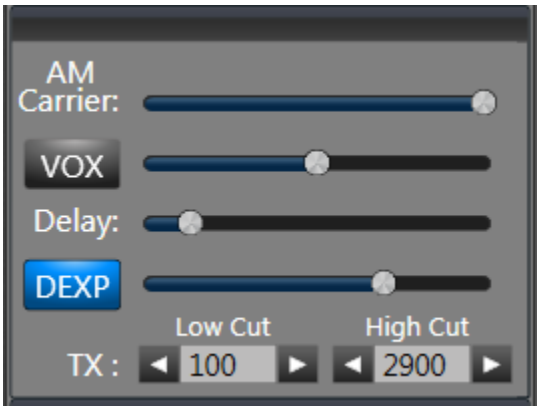

Transmitter Low Cut and High Cut bandwidth can be set on the Transmit Control panel. The bandwidth is adjustable up to 10 KHz in 1 Hz increments.

There are two indicator components of the microphone or input Level meter to show the actual audio input level. The left most component is a solid bar indicating the *average* input level and the smaller box like component farther to the right of the average input level bar is the *peak* level indicator. The Level meter indicator bars also utilize three colors to visually indicate the input level range. Signals up to -10 dB are shown in green. Signals levels between from -10 and 0 dB are shown in yellow. Any signal level that is greater than 0 dB is shown in red.

When setting up your microphone audio for optimal modulation, adjust the input gain so that the peak level indicator is peaking just BELOW the 0 dB on voice peaks. *It is very important that your peak level indicator never exceed 0 dB and turn red at any time.* A red peak level indicator indicates over-driven or "clipped" input audio levels resulting in audio distortion. The input ALC is active, but excessive input signal levels will result in input signals that can exceed 0 dB. If you see the peak level indicator turn red at any time, turn down your audio input gain until you no longer see the peak level indicator turn read.

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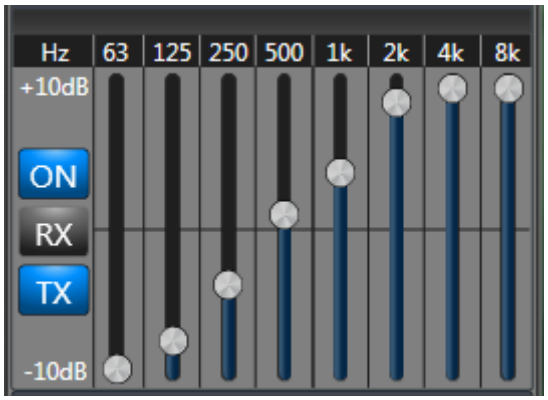
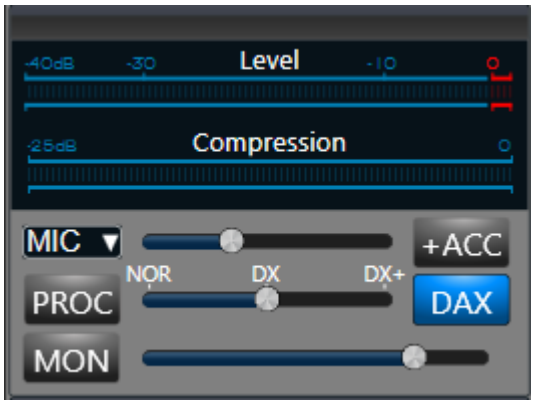


The Transmit Equalizer control panel is illustrated above with the TX and ON buttons highlighted. With these buttons selected, the graphic EQ can be optimized for different microphones and operating styles such as DX, contesting and ESSB. The sliders provide a +/- 10 dB adjustment range over eight octaves. The settings shown above provide very good audio quality for many dynamic microphones.

17.5 MONITOR MODE OPERATION



The MON button allows monitoring of the processed audio prior to the final brick wall filtering and ALC limiter. This gives a real time indication of compression and equalization settings on the transmitted audio. Monitor mode is enabled by engaging the MON button so that the monitor level may be controlled by the adjacent slider.

17.6 RECOMMENDED AUDIO ADJUSTMENT STEPS FOR VOICE MODES:

1. Select the desired microphone input from the drop down menu.
2. Select the desired transmit filter width on the Setup/Voice panel.
3. Turn the compressor off by pressing the PROC button so that it is not highlighted.
4. Adjust the TX Equalizer to compensate for the microphone and operating conditions. The default setting is optimized for most microphones. The TX EQ is located after the compressor/expander so it should typically be adjusted prior to engaging the compressor. Minor adjustments can be done after engaging the compressor/expander but care is needed to avoid excessive peaks.

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5. Speak into the microphone at the loudest voice level you would normally use.

6. Adjust the microphone gain control so that the peak indicator hovers near 0 VU on the Level meter. Some low output dynamic studio microphones may require the +20 dB gain selection located on the Setup/Voice panel.

7. Turn on the TX compressor/expander with the COMP button. The compression slider controls the Compression Threshold. At the minimum setting, the threshold is 0 dB while at max the threshold is approximately -33 dB. The compression ratio is fixed at 5:1 while the downward expander set for a threshold of -45dB with a ratio of 4:1.

8. Adjust the compression level control to the right of the COMP button to achieve the desired compression for the desired style of operation (e.g. DX/Contesting, ESSB, etc.). Note that the peak level indicated on the meter should not change significantly but the average should increase in proportion to the compression level. A normal compression level will be about -10 dB.

9. Adjust the transmit equalizer to optimize the audio for the desired operating style and microphone response.

10. If VOX operation is desired, enable the VOX button and adjust VOX gain/delay for proper operation.

17.7 HOW TO OPERATE VOX

Press the

button to enable voice operated transmit operation and adjust the VOX gain slider to adjust the VOX sensitivity. Sensitivity should be adjusted to the minimum that allows reliable keying by the voice without keying from other room noises. VOX delay sets the hang time before the transmitter unkeys after you stop speaking. Delay should be set to be comfortable for the style of operation desired.

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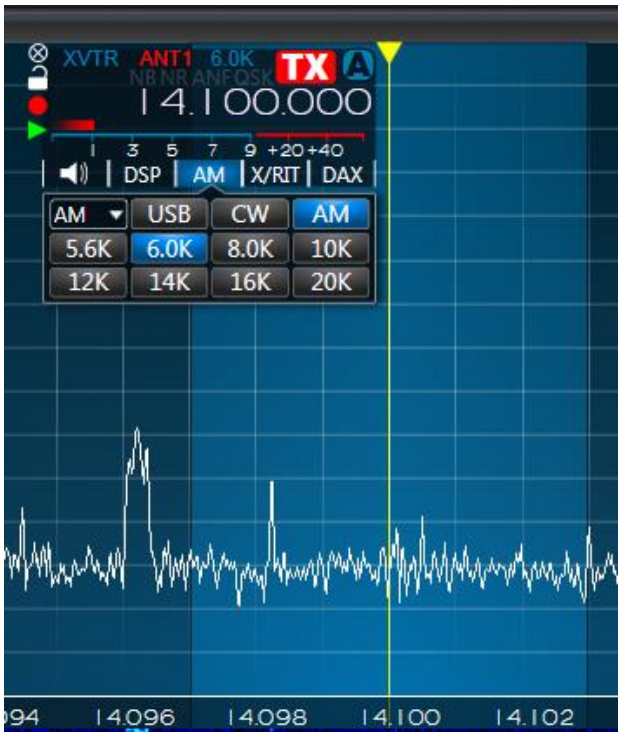
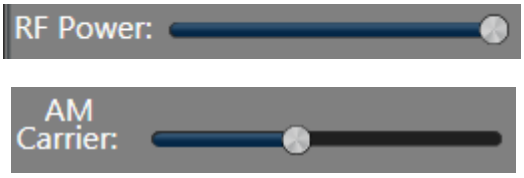
18 HOW TO OPERATE AM AND SAM



To operate AM or Synchronous AM (SAM) mode, select AM or SAM on the mode drop down menu. The receive AM bandwidth is selected on the drop down along with the mode selection. The carrier frequency indicator is shown at the center of the filter passband. Note that the filter bandwidth may be adjusted on either side by dragging the side of the filter with the mouse. This allows asymmetrical filter settings to get rid of heterodyne carriers or other interference on one side of the desired signal.



The AM Carrier control allows the carrier level to be set while maintaining a constant overall PEP output of the transmitter. With the AM Carrier control at full scale, standard 25% carrier operation is provided. When both the RF Power and AM Carrier controls are set to maximum, the carrier level will be approximately 25W and PEP output will be 100W. Reducing the RF Power control will reduce the carrier level and PEP in proportion. By reducing the AM Carrier level, the percentage of carrier relative to total PEP can be reduced to increase talk power in the AM sidebands. This is called Reduced Carrier AM.

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19 HOW TO OPERATE DIVERSITY RECEPTION (FLEX-6700 ONLY)

Diversity Reception is a powerful method for improving the reliability of a message signal by using two or more communication channels with different characteristics. Diversity is very useful for aid reception in weak and fading (QSB) signal conditions. With optimally configured antennas, weak signal QSB copy can be improved up to 75%.

Two common diversity methods are space and polarization. Both of these methods use separate antennas to receive different versions of the same signal. The FLEX-6700 incorporates two fully independent Spectral Capture Units (SCUs) that allow two separate antennas to be simultaneously digitized. The analog to digital converters (ADCs) on the respective SCUs are driven from a single clock source to provide stable synchronous reception. Since the FLEX-6500 and FLEX-6300 use a single SCU, they are not capable of diversity reception.

For best results antennas should be de-correlated in some way so that fading on one antenna is likely to be seen as increased signal strength on the other antenna. De-correlation can be accomplished by using different types of antennas (dipole and vertical), using the same type antenna at wide spacing (e.g. multiple wavelengths), or using the same antenna with different polarizations (horizontal and vertical or right and left). The more de-correlated the antennas the better but even small amounts can be beneficial. One interesting example of the application of circular polarization diversity on HF is discussed in the December 2010 *QST* article, "Gimme and X, Gimme an O, What's that Spell? – Radio."

The diversity implementation provided in SmartSDR v1.3 is intended for use only with headphones. Two Slice Receivers attached to separate antennas are automatically routed to the left and right ears so that the brain can provide discrimination between the signals. The reason speakers are not used is that they allow the signals to combine in the space between the speakers to cause undesirable peaks and nulls in the sound. For example, Slice A could be set to RXA and Slice B to RXB.

As seen in the screen shot below, a weak SSB signal has been tuned on Slice A attached to ANT1. The DIV button has been selected on the slice DSP drop down to enable Diversity and pop up the slaved diversity Slice B on ANT2 locked to the same frequency as Slice A. Note that RXA, RXB, and XVTR ports are also available for receiver inputs. SmartSDR automatically sets the slice audio faders to place the two antennas the left and right ears respectively. Your brain does the rest. Remember that the sound will be very different from normal reception since you are literally listening in stereo to the same signal on two different antennas.

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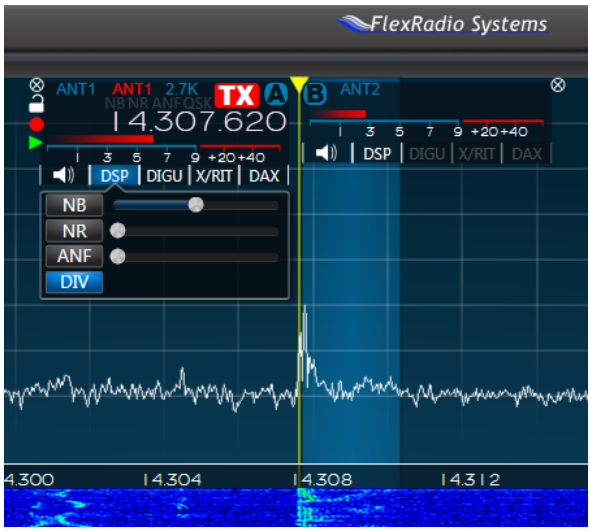

SmartSDR automatically sets the slice audio faders to place the two antennas in the left and right ears respectively. The sound will be very different from normal reception since the user is listening in stereo to the same signal on two different antennas.

20 HOW TO OPERATE THE ATU

Press the ATU button to initiate tuning on the Automatic Tuning Unit. The ATU will set the power output to approximately 2W on 6m and 10W on all other bands. The ATU will tune until it achieves a successful impedance match as shown by the Success indicator. The ATU button will remain lit to show that the ATU is engaged. If the ATU cannot achieve a successful match, the red Fail indicator will light and the tuner will revert to bypass mode.

In the event that the measured antenna SWR is lower than the ATU than the final tuning outcome, the ATU will switch into bypass mode indicated by the highlighted BYP button and the Success indicator will light.

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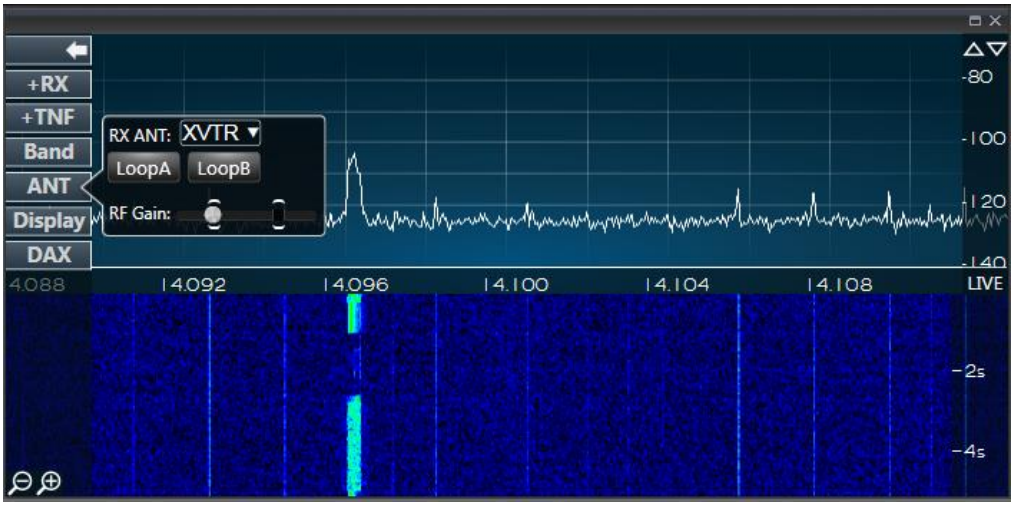
21 HOW TO CONFIGURE ANTENNAS

21.1 GETTING STARTED

When SmartSDR starts for the first time, it loads a single panadapter and slice receiver with Antenna 1 (ANT1) selected by default. Transceive operation is then functional on ANT1 with no further setup or adjustment required.

21.2 SELECTING THE RECEIVE ANTENNA FOR A PANADAPTER WITHOUT SLICE RECEIVERS



The display above shows a single panadapter without any Slice Receivers activated. The panadapter receive antenna is selected on the ANT pop out menu on the left side of each panadapter. LoopA or LoopB (Not available on FLEX-6300) may be selected along with the RF Gain for the associated panadapter.

21.3 USING THE PANADAPTER ANT POP OUT MENU

The pop out menus provide receive antenna selection and RF Gain control for the FLEX-6700 (left), FLEX-6500 (center) and FLEX-6300 (right). Changing the configuration on this menu affects the receiving setup for all slices located on its panadapter. Changing the receiving antenna on any slice within the panadapter changes the configuration for its panadapter and all slices located within.

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The slice receiver flags allow drop down selection and annunciation of the receive antenna selected for its panadapter and all respective slices located therein. The left flag shown above shows the options allowed on a FLEX-6700, the center flag shows those available on the FLEX-6500 and the right flag shows the FLEX-6300. The RX B input selection is only available on the FLEX-6700 since it contains two independent SCUs.

Loop selection is provided only from the panadapter ANT menu but is indicated under the receive antenna selector on each slice within the respective panadapter. The LoopA annunciator can be seen under ANT1 in the Slice A flag shown above. This means that the RX A loop is active and connected to ANT1.

21.4 SELECTING THE TRANSMIT ANTENNA FOR A SLICE RECEIVER

The transmit antenna for each slice is selected from the red drop down menu shown on Slice A above. The transmit antenna selector offers the same ANT1, ANT2, and XVTR options on both the FLEX-6500 and FLEX-6700 models. Each slice may have its own designated transmit antenna that is activated by the large red TX button to the left of its slice letter (e.g. Slice A in above).

21.5 ANTENNA OPTIONS FOR PIN DIODE QSK OPERATION

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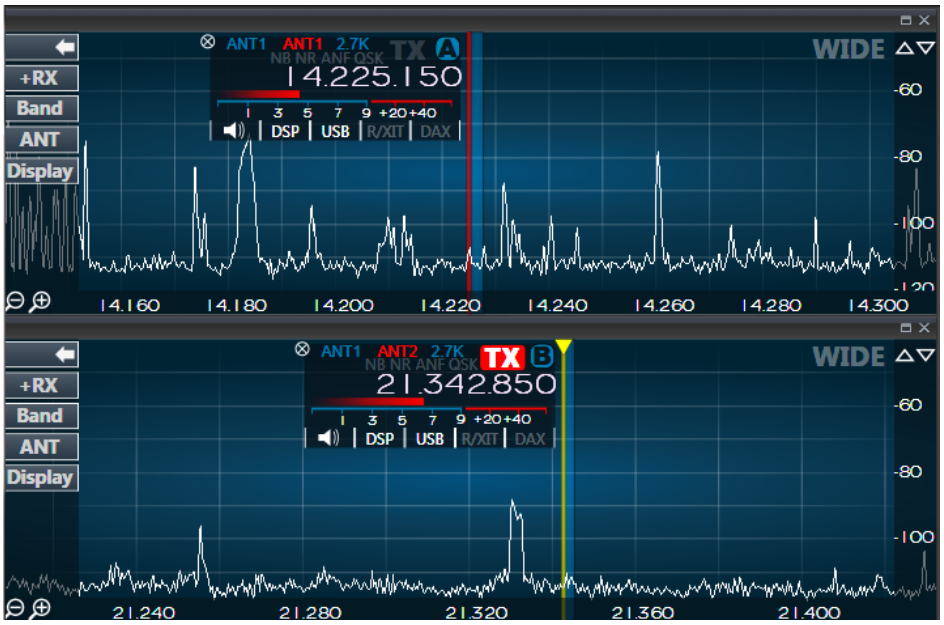
Full QSK operation with reception between individual elements is supported on a single transceive antenna at speeds up to 30 WPM. QRQ QSK is supported at 100+ WPM when a separate receive antenna is used on RX A, RX B or XVTR. The QSK annunciator located to the left of the TX selector button on each flag indicates that QSK is operational in the selected mode. QSK is not supported with a separate receive antenna set to either ANT1 or ANT2.

21.6 USING A COMMON RECEIVE ANTENNA WITH SEPARATE TRANSMIT ANTENNAS



The display above illustrates two panadapters on a single receive antenna (ANT1) but having separate transmit antennas on ANT1 and ANT2 respectively. Slice A and B both have ANT1 selected. Slice A has ANT1 selected as the TX antenna and Slice B has ANT2 selected as the TX antenna. Clicking on the TX indicator for the slice changes the TX indicator to red and activates the respective slice as the transmitter with its TX antenna.

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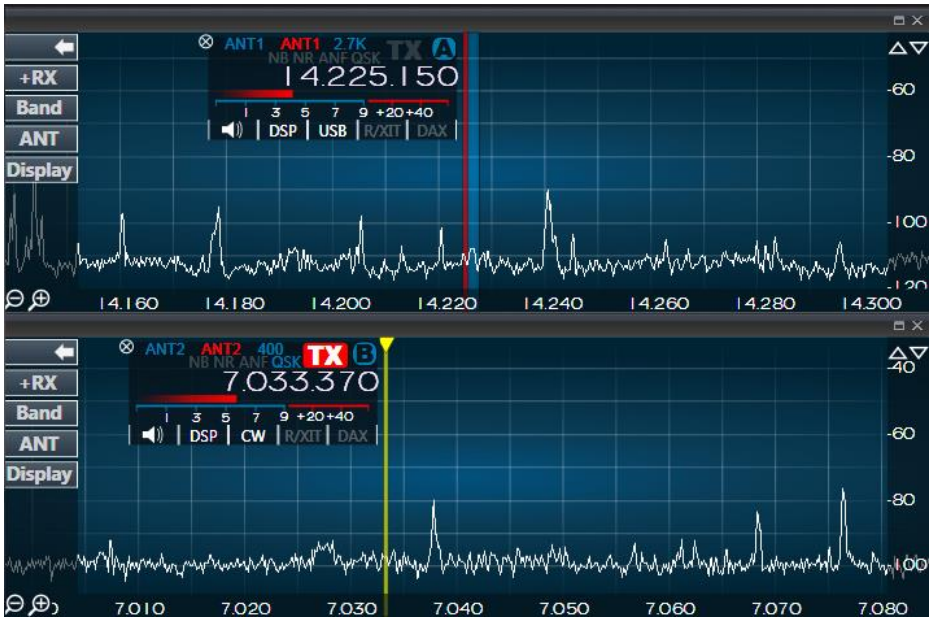
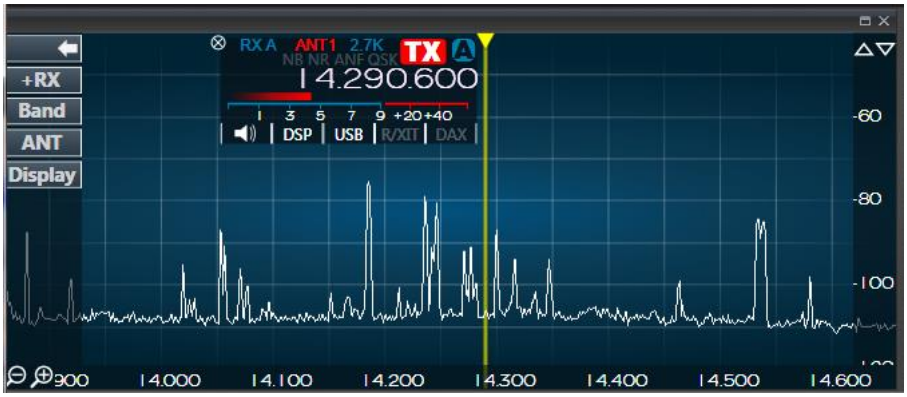
21.7 USING TWO TRANSCEIVE ANTENNAS ON THE FLEX-6700



In the display above, the Slice A is set to receive and transmit on ANT1. Slice B is set to receive and transmit on ANT2. The Slice B is selected as the active transmit frequency of 7.033 MHz on ANT2 as indicated by the red TX button. To move the transmit frequency to 14.225 MHz on ANT1, simply click the TX button on Slice A.

21.8 USING A DEDICATED RECEIVE ANTENNA



The above display shows Slice A having a dedicated receive antenna on RX A with the transmit antenna ANT1. The FLEX-6700/6700R models have the option of two separate receive antennas on RX A and RX B respectively. The FLEX-6500 has only the RX A option. The FLEX-6300, FLEX-6500 and FLEX-6700 all have the option of receiving from the XVTR port. *The XVTR port is not recommended as a receive antenna port if an external preamp is used on its antenna. Transmission on the XVTR port could put up to +10 dBm of reverse power into the connected preamp.*

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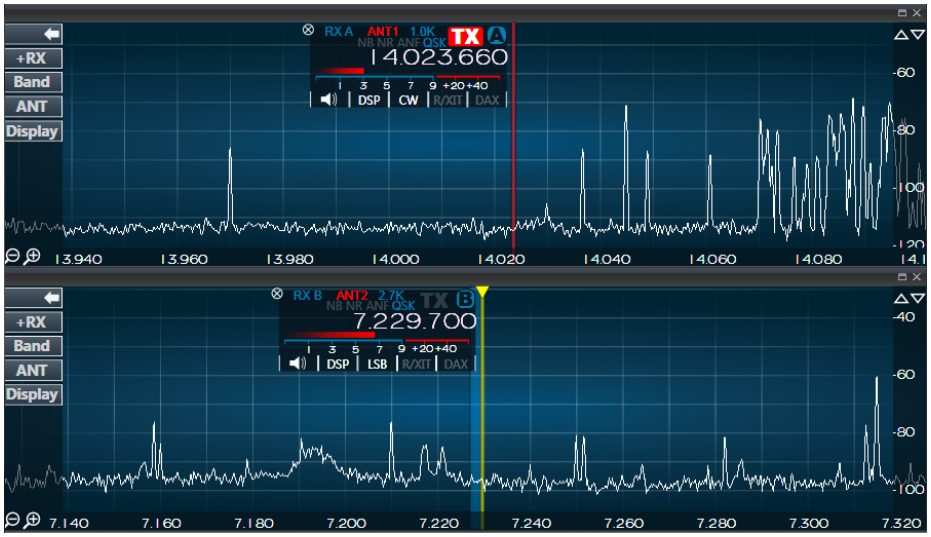
21.9 RECEIVE ONLY ANTENNA OPERATION



The display above is configured on a FLEX-6700 so that Slice A receive antenna is set to RX A and Slice B to RX B. ANT1 is selected as the transmit antenna for Slice A and ANT2 for Slice B. This configuration allows separate receive antennas on the two independent SCUs. This configuration is not available on the single SCU FLEX-6500 or FLEX-6300. In the above illustration, Slice A is selected as the transmit frequency. To change the transmitter to Slice B, simply click its TX button.

21.10 ANTENNA SELECTION FOR TRANSVERTER OPERATION

The left slice flag above shows XVTR selected for both receive and transmit antennas. This provides common transverter port transceive operation. The slice flag on the right illustrates the setup where RX A is set as the receive antenna and XVTR as the transmit antenna. This mode supports split transmit/receive transverter operation.

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21.11 ANTENNA CONFIGURATION BASIC TERMS AND RULES

For more advanced antenna configurations it is helpful to define terms used to describe the FLEX-6000 Signature Series architecture and the rules associated with its configuration.

1. A Spectral Capture Unit (SCU) is a direct sampling, wideband digitizer that captures the entire RF spectrum within its input filter limits.
2. The FLEX-6700/6700R models contain two fully equivalent but independent SCUs. The FLEX-6500 and FLEX-6300 contain a single SCU.
3. The FLEX-6700/6700R models can simultaneously digitize two antennas, one for each SCU, while the FLEX-6500 and FLEX-6300 digitize a single antenna.
4. Each panadapter spectral display requires selection of an associated receive antenna. The default association for the first panadapter is ANT1.
5. One or more Slice Receivers may be placed on one or more panadapters.
6. Multiple slices and panadapters can share a single receive antenna.
7. SmartSDR v1.2 allows up to eight panadapters and eight slice receivers on the FLEX-6700/6700R models and up to four panadapters and four slice receivers on the FLEX-6500. The FLEX-6300 allows up to two panadapters and two slice receivers.
8. All Slices placed on a panadapter must use the same receive antenna as the panadapter. Changing the receive antenna for a single slice will change the receive antenna for its host panadapter and all slices within.
9. The FLEX-6700/6700R models allow simultaneous reception from two receive antennas. The FLEX-6500 and FLEX-6300 operates from a single receive antenna.
10. The receive RF Gain control located on the panadapter ANT pop out menu is tied to its respective SCU/ receive antenna combination.
11. Transmit antenna selection is completely independent of the receive antenna. Only one transmit slice can be active at one time.
12. The transmit slice is selected by clicking on the large "TX" button on the slice flag, which will illuminate the button in red.
13. ANT1 and ANT2 ports allow transmission at 100W on 160m through 6m amateur bands. The XVTR port allows continuous coverage low power (+10 dBm max) transverter IF from 100 KHz to 165 MHz.
14. Each slice can have its own transmit antenna selection, which may be the same as or different from it's receive antenna.
15. Each SCU on the FLEX-6700 has the option of a dedicated receive only antenna designated RX A and RX B respectively. These inputs are hard wired to their respective SCU and may not be switched between SCUs. Note that this does not preclude using RX A with ANT2 or RX B with ANT1.
16. The single SCU on the FLEX-6500 has the option of the dedicated receive only antenna input RX A.
17. LoopA and LoopB on the FLEX-6500 and FLEX-6700 are provided to allow connection of external preamplifiers or preselectors. The internal relay switching is identical to RX A and RX B respectively. However, LoopA and LoopB is a logical designation that assumes that their input is

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from one or both of ANT1 and ANT2. This means that a preamplifier installed in LoopA will be functional if either LoopA or RX A are selected. Logically RX A will assume a receive only antenna connected to RX A and LoopA will assume that a device is connected between RX A IN and RX A OUT.

18. The XVTR input/output port may be used on the FLEX-6300, FLEX-6500 and FLEX-6700 as another receive only input or may be used as a transverter transmit or common receive port. RX A and/or RX B on may be used for split transmit receive operation when selected as the receive antenna and XVTR as the transmit antenna.
19. Pin diode silent CW QSK operation on ANT1 and ANT2 require that both receive and transmit be on the same antenna or that a dedicated receive only antenna be used on RX A, RX B, or XVTR. If ANT1 and ANT2 are used separately as receive and transmit antennas, the transmitter reverts to mechanical relay TR switching. Each slice has a QSK annunciator that indicates when pin diode TR switching is engaged.

22 HOW TO CONFIGURE TRANSVERTERS

To configure transverters, first bring up the transverter configuration panel in SmartSDR by clicking Settings… Radio Setup… and the selecting the XVTR tab. The radio setup panel should look like this:

To add a transverter band, click the plus (+) tab. A new transverter band tab will show up which has blanks that need to be filled in with information about your transverter. The first blank holds the name of the transverter or transverter band. Generally, you would enter something like "1296" for 1296MHz or "10G" for 10.368GHz, but you may enter any 4-character descriptor for the band that suits you. Next, the RF frequency in MHz is entered followed by the IF frequency in MHz. This is followed by any error in your local oscillator, a maximum output power from the radio and then any IF gain in your transverter. Here's a detailed description of each field and what you would input or see in the field:

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Name: holds the name of the transverter, generally a reference to the RF frequency of the transverter. This name must be 4-characters or less. The name will be displayed in the panadapter during transverter use as a reminder that RF will be passing through the transverter. The name is also used on the transverter band selection panel discussed later.

RF Freq (MHz): the output RF frequency of your transverter. This is the frequency that the final antenna will work on. Note that the RF frequency and the IF frequency are directly related by the LO frequency. You must enter an RF frequency that will be directly translated to the IF frequency. For example, if you enter "1296" for a 1296 to 28MHz transverter, you must enter "28" in the IF frequency. Do not use "1296.1" for one and "28.0" for the other unless this is the way your transverter is configured. If you have any doubts, be sure that the LO frequency calculated by SmartSDR matches the LO frequency of your transverter.

IF Freq (MHz): the IF frequency that corresponds to the RF frequency previously entered. Currently SmartSDR only understands high-side injection so the IF frequency must be below the LO frequency of your transverter.

LO freq (MHz): the calculated value of the local oscillator in your transverter. This number should match the transverter manufacturer's specifications. If it does not, check the RF and IF entries again and make corrections.

LO error (Hz): If your local oscillator is off-frequency by a known amount, enter that amount here and SmartSDR will make the proper adjustments to properly read your transmit and receive frequencies in SmartSDR. If you are using a GPS or 10MHz locked transverter, this number should be set to zero.

RX Only: Enable this if you do not want to transmit through your transverter. It will lock-out the transmit capabilities in SmartSDR.

Max Power (dBm): enter the IF input power level to the transverter to achieve maximum output power of the transverter. This will limit the output power that SmartSDR allows to be provided to the transverter. This value may be between -11dBm and +15dBm for IF frequencies below 80MHz and -11dBm to +8dBm for IF frequencies above 135MHz.

RX Gain (dB): this field is optional, but will correct the receive signal level reading in the panadapter and slice receivers. To properly set this, you should enter the IF gain for the transverter. If you do not know this value, ask your transverter manufacturer. If you do not have this number available, it may still be calculated by inputting a known value signal into the transverter, reading the receive level in SmartSDR and then adjusting the RX Gain until the values are equal.

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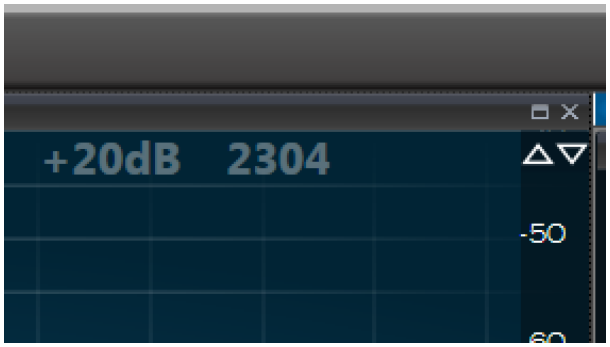
Below you can see a completed transverter setup form with a single band entered:

The green "Valid" indicates that SmartSDR has enough information to use the transverter.

When operating in a Transverter band the Transverter name will appear in the top right corner of the panadapter as shown below:



22.1 USING A TRANSVERTER

There are two ways to tune to a transverter. The first way is to use the band select panel in the panadapter (shown below). To get to the transverter band panel, first select Band in the panadapter and then click the XVTR button at the lower right of the panel of buttons that appears. Next select the transverter band you wish to use. The buttons in the panel use the name of each transverter specified in the transverter setup form.

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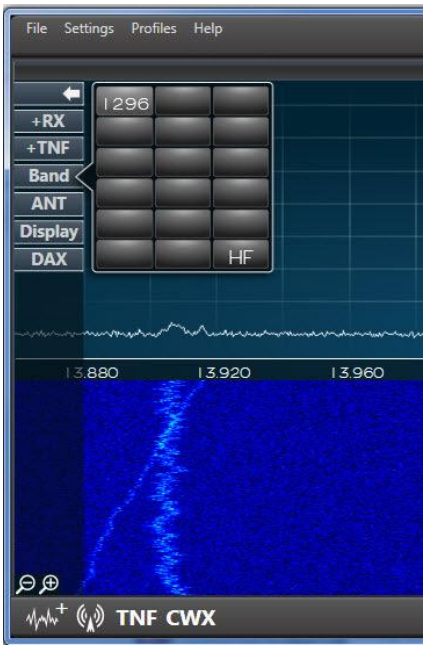
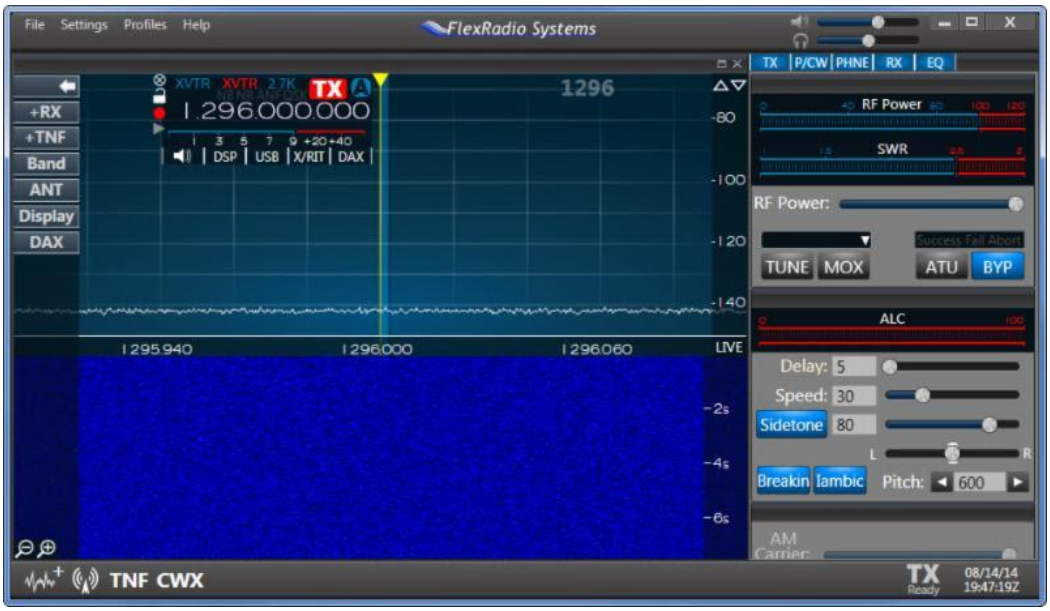


When the band button for a transverter is clicked, the radio will change the frequency of the panadapter to the transverter frequency. Below you can see that we are now on 1296.0MHz and there is now a band indicator in the upper left of the panadapter that indicates that we are on the 1296 transverter.



The FLEX-6000 is actually receiving on the IF frequency and performing a frequency translation in the slice and the panadapter to indicate the frequency being listened to.

If you have more than one transverter on the same band, you can name them differently and then access them with different transverter buttons. Each transverter band behaves just like an

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HF band in that it remembers settings used for that band. If you were to QSY (change frequency) to 1296.1, SmartSDR will remember that this is the last frequency used on the 1296 transverter band. All other features of SmartSDR including multiple slices, wide bandwidth views of the spectrum, etc. are all available on the transverter band.

To return to an HF band, simply enter the HF frequency that you wish to QSY to or select the band with an HF band button.

The second way to select a transverter band is to directly enter the frequency of the desired operation into the slice receiver. For example, entering "1296." (don't forget the decimal point to tell SmartSDR that we want to go to 1296MHz) will move the panadapter and slice to 1296MHz.

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22.2 MULTIPLE COPIES OF A BAND

In some situations, it may be desirable to have multiple copies of a signal frequency in the radio. For example, if you have a high power 144 to 28MHz transverter in use on a FLEX-6700, the radio will not definitively know whether to tune to the internal 144MHz band or to the external transverter. This ambiguity is resolved in two ways: First, if the band is selected using the band buttons, the radio will always know which band to switch to. In the event that direct frequency entry is used, the following rules are used to select the band of operation:

1. If the panadapter is currently in a band that would match the entered frequency, SmartSDR remains on the current band
2. The most recently used band that matches the frequency entered will be selected.

Example:

- The current panadapter is tuned to 50.125MHz
- There is an external 144 to 28MHz transverter on a FLEX-6700 with an internal 2m band
- The most recently used 144MHz band is the external 144-28MHz transverter
- A direct frequency entry of "144.2" is typed
- The radio will select the external 144-28MHz transverter and tune to 144.200MHz
- The panadapter will clearly indicate the selected band by placing a "144" (or whatever name was given to the transverter band) in the upper right of the panadapter

If this is not the desired result -- if you intended to switch to the internal 2m band, just use the Band selection to switch to this band in the panadapter. At this point, the radio will switch to the correct band and it will become the "favorite" band next time a direct frequency is entered.

22.3 TRANSVERTER POWER SETTINGS

The operation of the RF power slider in SmartSDR is set by the Max Power setting in the transverter setup. Setting the RF power slider to 100 will set the power to the Max Power setting. The zero setting will shut off all RF power from the transverter port. A setting of 1 would be 20dB below the max power. For example, if a Max Power setting of +5dBm was set in the settings, the slider "0" position will be no power, "1" will be +5dBm - 20dB = -15dBm. The 50% setting on the slider will be +5dBm - 10dB = -5dBm.

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22.4 TRANSMITTING ON A TRANSVERTER

When transmissions occur on the transverter, the radio will reconfigure internal relays to connect the exciter in the FLEX-6000 to the XVTR port on the radio. If a split IF is in use, the RXA or RXB port may continue to be used for receive provided that your transverter continues to provide receive RF (check with transverter manufacturer). When a common IF transverter is used, the XVTR port normally being used for transmit will be switched away from the FLEX-6000 SCU and connected to the exciter. As a side-effect, the relay may connect the SCU to one of the HF antenna ports which would cause the panadapter to show HF signals. If you are on 1296.1 MHz and suddenly see receive signals from 28.1MHz in the 10m band from your 10m antenna, this could be quite confusing. For this reason, the panadapter will freeze for common IF transverters when transmitting.

22.5 WEAK SIGNAL CONSIDERATIONS

When using SmartSDR for weak signal operations, three kinds of receivers will be in use: Panadapters, Waterfalls and Slice Receivers. The noise floor of the panadapter may be changed to facilitate seeing signals that are weaker than the "noise floor." Amateurs generally refer to the noise floor as the noise floor in a 500Hz bandwidth receiver. For a SmartSDR panadapter, the receiver is variable width for a single "bin" or pixel in your display. The further you zoom in the panadapter, the lower the bin size in use and the lower the noise floor. The processing gain achieved in this way is 3dB for each reduction in the bandwidth of a bin by two --- or each time the magnifying glass '-' is depressed.

On a FLEX-6700 fully zoomed in, the bin size will be 1.5Hz. This represents a 25dB gain over the 500Hz noise floor. The waterfall and panadapter both derive data from the same receiver so for best weak signal viewing, zoom the panadapter to one of the last few zoom levels. On a FLEX-6500 or FLEX-6300, the minimum bin size is 5.9Hz.

The noise floor of the slice receiver is independent of the panadapter and is adjustable by adjusting the filter width of the slice receiver. Your ears and brain provide their own type of processing gain and so the slice receiver should be adjusted for best listening experience. In general, the AGC-T should be set to a fairly low value for best listening on transverted bands. In other words, it should be adjusted for a relatively quiet receiver.

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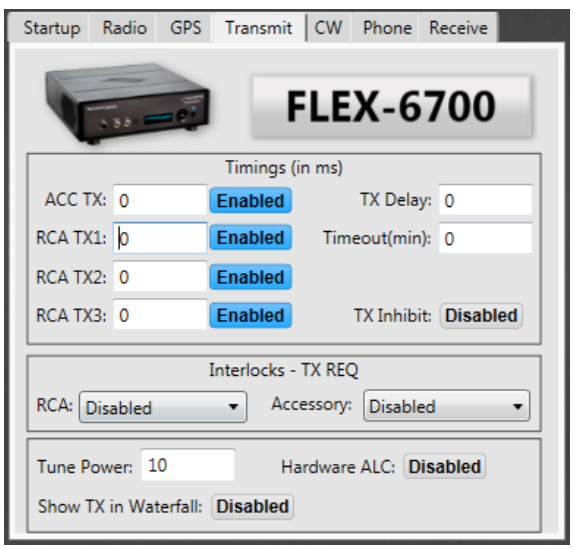
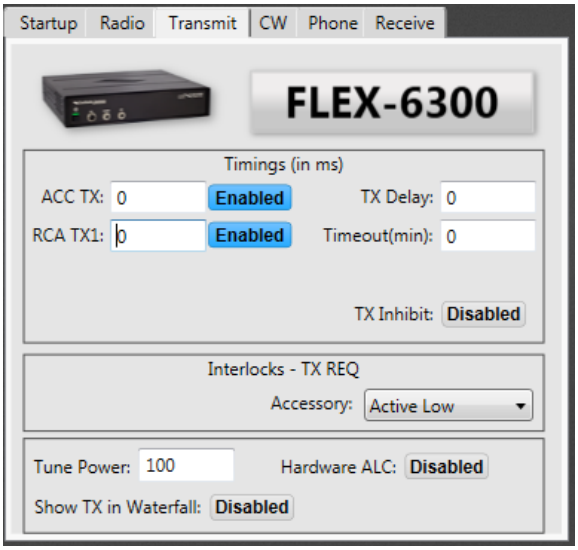
23 HOW TO CONNECT AN EXTERNAL AMPLIFIER

The FLEX-6000 has hardware interfaces for connecting an external power amplifier. There are four PTT outputs on the FLEX-6700 and FLEX-6500 and two outputs on the FLEX-6300, each with independently configurable time delays, a transmit hold-off input for amplifiers that have QSK hold-off outputs, and a standard zero to negative four Volt hardware ALC input. SmartSDR controls the configuration for these interfaces using the TRANSMIT tab in the Radio Setup menu. (Left: FLEX-6700/6500 Right: FLEX-6300)





On the FLEX-6700 and FLEX-6500 there are four PTT outputs. Three are RCA jacks on the rear panel, labeled TX1, TX2, and TX3. The FLEX-6300 has one RCA jack labeled TX. On each of the radios there is an output on Pin 11 of the Accessory connector on the rear panel as well. These outputs are isolated, and each one can have a specific delay. Some users will want to utilize the delay settings to sequence switch external equipment.

For external amplifier use, the delay should be set to zero for any output that keys the external amplifier. This will insure the relay will follow the PTT signal exactly.

The TX Delay setting can be used if the external amplifier has slow T/R relays and requires a longer time between PTT and RF Emission. Unless you are noticing problems with the radio emitting RF before the amplifier has switched to transmit position, you should leave the TX Delay set to zero.

The TX Delay will have a negative impact on QSK operation. If the intent is to operate QSK then Delay should be set to zero.

The Interlocks settings are used for amplifiers that have a hold-off output for QSK CW. There are two interlock inputs. One is an RCA jack on the rear panel, and the other is Pin 13 of the Accessory connector on the rear panel. On the FLEX-6300 this is only available on the Accessory connector

If your amplifier does not have one of these outputs, or you do not use it in your station, leave these settings disabled. If you need to use the hold-off, select Active High or Active Low to enable the interlock and set the proper polarity of the signal provided by the amplifier.

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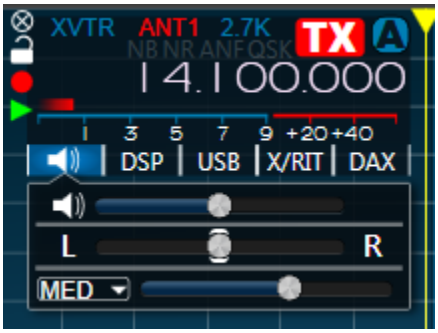
24 HOW DO I RECEIVE

The FLEX-6000 has a number of digital-signal-processing functions that enhance receiving in noisy environments.

The receiver Automatic Gain Control can be adjusted for optimum performance in noisy or quiet environments.

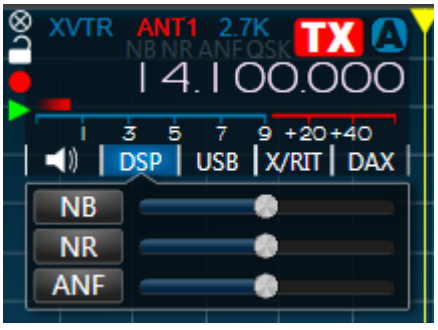
The Automatic Gain Control threshold adjustments are located with the slice audio controls; it is the bottom control in the audio panel. Each slice receiver can have its own settings for the AGC timing and threshold.



The dropdown sets the attack and release time for the AGC. You can choose FAST, MEDIUM, SLOW or OFF. Off disables the automatic gain adjustment and allows you to set the gain manually. It will not change in response to the received signal strength.

The proper setting for the AGC threshold is determined by the band noise and the signal strength of the desired signal. Reducing the threshold can significantly improve the signal-to-noise ratio of the desired signal. Increasing the threshold will increase the gain in the receiver, which is sometimes necessary for weak signals. Properly adjusted, you can virtually eliminate noise and have a very clean signal that is very pleasant to hear.

In the slice DSP control panel are the enable buttons and threshold adjustments for the Noise Blanker, Noise Reduction, and Automatic Notch Filter. The midrange setting of the threshold controls are good starting points for adjustments.



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The Noise Blanker is to combat impulse noise such as power line hash. To enable the Noise Blanker, click the NB button, then adjust the threshold control for the best noise suppression. In general, the default setting is adequate, but depending on the noise, some adjustment can help.

The NB threshold control adjusts the level at which a sample is considered to be impulse noise. The general rule of thumb for this adjustment is to use the lowest level that is effective. For large impulse noise (meaning the noise floor jumps are large) then a lower level should be used. If the impulse noise is causing only small jumps in the noise floor, a higher level can be used.

Large signals, both in the passband and around it can cause the NB to distort the audio if the threshold control is set too high.

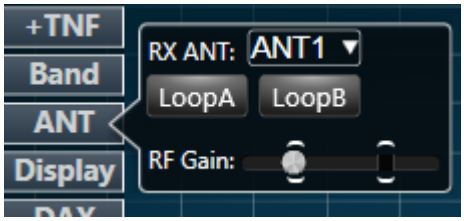
The Noise Reduction will eliminate most of the background noise and make the signals more readable. It's best to adjust the AGC threshold first, then enable the Noise Reduction.

Both the Noise Reduction and Automatic Notch Filter algorithms use a correlation based adaptive filter. The Noise Reduction increases correlation between Input and Output with the assumption that noise is uncorrelated and should be canceled out. The threshold adjustment controls the adaptation rate of the filter, so in the case of Noise Reduction, there will be very little audible change while adjusting the threshold unless the noise is changing rapidly or dramatically.

The Automatic Notch Filter decreases correlation of the Input and Output since a tone is highly correlated and should be canceled out. The threshold adjustment controls the adaptation rate of the filter. If there is a loud tone and you move the receive filter around it you should hear the tone get canceled at different rates depending on the threshold control setting.

24.1 HOW DO I USE RECEIVE PREAMPLIFIERS

Each Signal Capture Unit in the FLEX-6000 includes a preamplifier with adjustable gain. The RF gain selector is located in the ANT menu on the left side of the screen.



- The FLEX-6300 can be set to 0dB (default) and +20dB (Note: Since the FLEX-6300 always operates in wide band mode, the preamplifier incorporates a tapered gain with -3db cutoff located at ~14 MHz. This technique is optimized so that preamp gain and improved noise figure is provided above 14 MHz, and the gain is tapered below 14 MHz to offset the rising noise levels below 14 MHz)
- The FLEX-6500 can be set to -10dB, 0dB (default), +10dB and +20dB.
- The FLEX-6700 can be set to -10dB, 0dB (default), +10dB, +20dB and +30dB.

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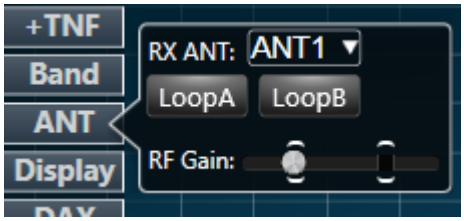
24.2 SETTING THE RF GAIN/PREAMPLIFIERS



Each Signal Capture Unit in the FLEX-6000 includes a preamplifier with adjustable gain. The RF gain selector is located in the ANT menu on the left side of the screen. The gain range is selectable in 10 dB steps from -10 dB to +30 dB on the FLEX-6700, -10 dB to +20 dB on the FLEX-6500 and 0dB to +20dB on the FLEX-6300. The default setting is 0 dB. For typical HF operation below 12m, the 0 dB setting provides the highest dynamic range and is recommended for most locations. Even in quiet rural locations, gain is not needed or desired unless a low gain/low noise antenna is utilized.

The best way to determine the amount of gain needed for a given antenna and band condition is to disconnect the antenna and measure the receiver noise floor with the slices dBm meter. Hover the mouse pointer over the S meter to enable the pop up dBm meter indicator. Next connect the antenna. If the band noise measurement without a signal present in the passband is 8 dB or more higher than that with no antenna, additional gain is not needed. If a directional antenna is used, it should be pointed toward the band opening for this measurement because noise propagates with the opening.

Note that although the RF gain slider is present in every panadapter, the gain setting control the preamplifiers that are in an SCU. If you adjust the preamp settings for one panadapter, all other panadapters on that SCU will also be changed since the change is actually made to the SCU. For operational purposes, this equates to a "per antenna" basis. In the case of the FLEX-6500 with a single SCU, the preamplifier settings affect all panadapters and receivers.

There is a preamp indicator that will be lit whenever the preamp/attenuator is turned on for the band. It will show the requested gain for a FLEX-6500 or FLEX-6700 (such as +20dB). On the 6300, the preamp actually provides different levels of gain by frequency. If there is a net +5dB or better gain, the indicator will show PRE. If there is a net -5dB or less gain (attenuation) then the indicator will read ATTN. If it is in-between these two values, it will read ---- to indicate that the preamp is on, but not providing much change in the band of interest. This means on a 6300 that one panadapter could have PRE and the other ATTN.

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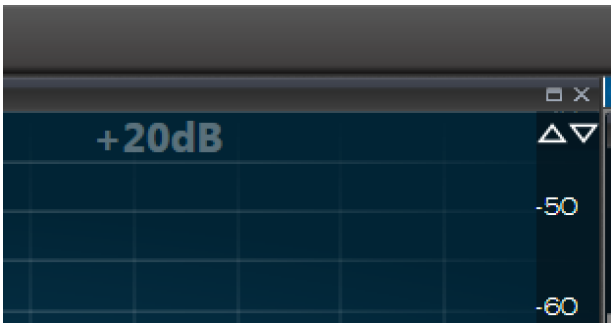

25 DIGITAL MODE SETUP WITH THE FLEX-6000 AND SMARTSDR FOR WINDOWS

In the initial versions of SmartSDR, configuring a FLEX-6000 for operating digital modes is essentially the same as most analog/DSP radios. That is an analog audio interface is connected from the radio hardware to a PC sound card. In a future version of SmartSDR, audio will be streamed digitally from the radio over the Ethernet connection to the PC via the IP protocol. In the meantime, the following procedure can be used for operating digital modes with the FLEX-6000.

This procedure assumes that you have a working knowledge of operating digital modes with your favorite sound card based digital mode program and will not delve into the details of configuring specific third-party digital mode programs. For the examples in this procedure, Fldigi v3.20.x will be used.

25.1 PREREQUISITES

1. Connecting the FLEX-6000 to a PC sound card
2. Configuring a PTT interface
3. Installing SmartSDR CAT

25.1.1 CONNECTING THE FLEX-6000 TO A PC SOUND CARD

There are several audio inputs and outputs on the FLEX-6000 that can be used for connecting the radio hardware to a PC sound card. Please refer to the FLEX-6000 Hardware Reference Manual for a detailed description and location of the following audio inputs and outputs.

The basic audio schematic is used to connect a FLEX-6000 to a PC sound card:

PC Sound Card Mic / Line In <---> FLEX-6000 Audio Output

PC Sound Card Line Out / Speaker Out <---> FLEX-6000 Audio Input

FLEX-6000 Inputs:

Front Mic Connector [MIC] (8-pin Foster)

Rear Balanced Input [BAL] (3-pin XLR)

Rear Line Input [LINE] (1/4" TRS connector)

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Rear Accessory input [ACC] (15-pin D-sub connector)

FLEX-6000 Outputs:

Front Headphone connector (1/4" TRS connector)

Rear Powered Speaker connector (1/8" TRS connector)

Rear Accessory output (15-pin D-sub connector)

The audio input and output you choose is mostly a matter of your operating preferences. For example, if you also operate phone modes, you may not want to constantly disconnect your microphone and speakers to facilitate the connection to the PC sound card, so you may want to use the Accessory connector for both the audio input and output. In the following example, the left channel audio output on the Accessory connector is used to facilitate both the input and output audio connections to the PC sound card. A detailed schematic of the ACC connector's audio connections can be found in the FLEX-6000 Hardware Reference Manual.

When connecting the FLEX-6000 to a PC sound card, connect one of the FLEX-6000 inputs to the LINE OUT on the sound card and one of the FLEX-6000 outputs to the MIC or LINE IN on the sound card.

25.1.2 CONFIGURING A PTT INTERFACE

In order to key the radio from transmitting digital modes either a CAT connection or serial port PTT interface can be used. The most common method is to use CAT commands to key and un-key the radio, but either a physical or virtual serial port can be used too.

For this procedure, SmartSDR CAT will be used to key and un-key the radio via the SmartSDR CAT protocol. SmartSDR CAT will also properly translate Kenwood CAT commands too. Please refer to the SmartSDR CAT Users Guide for additional information regarding the CAT protocol.

25.1.3 INSTALLING SMARTSDR CAT

SmartSDR CAT is a FLEX-6000 client application that translates serial port CAT commands into FLEX-6000 "FlexLib" commands and is included with SmartSDR for Windows. It must be installed before setting up your digital mode configuration. Please refer to the SmartSDR CAT User Guide for detained instructions for installing SmartSDR CAT.

After SmartSDR CAT is installed, note the virtual server port number assigned to your FLEX-6000. The default FlexRadio virtual com port is COM4 and will be used in this set procedure. Once SmartSDR CAT is installed you can use the Test tab to verify that SmartSDR CAT is properly communicating with the FLEX-6000.

25.2 SMARTSDR FOR WINDOWS SETUP

As noted above, we have connected the FLEX-6000's audio input and output via the **ACC Connector** to a PC sound card. In this example we will be using an Edirol FA-66 sound card, but any PC sound card is suitable for operating digital modes.

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25.2.1 SLICE RECEIVER SETUP

Create or modify a slice receiver for operating digital modes. Since all of the audio from all slice receivers is mixed together in the audio output, it is best to only have one slice receiver defined so that you do not have to worry about muting the audio for other slice receivers.

Change the Demodulation mode to DIGU or DIGL. DIGU (upper sideband) is the ASFK demodulation mode most commonly used for digital mode operation.

Verify that the Audio Pan control is in the center position. To ensure that audio will be sent to the sound card, make sure that the Pan audio control is in the center position. (See the slice receiver control panel image below.

25.2.2 SmartSDR Audio Output Configuration

The audio outputs of all slices are constantly being sent out the audio outputs unless you have explicitly muted the output.

The audio output gain level is adjusted by two different controls; the master audio gain and the slice audio gain.

If using the **ACC** or **Powered Speaker** audio output on the FLEX-6000, the **Speaker Master Gain** slider (the top most slider shown in the image below) is used to adjust the audio output being sent to the PC sound card. Consequently, if you have connected the headphone jack to the PC sound card, you will use the **Headphone Master Gain** slider to adjust the audio output being sent to the PC sound card.

25.2.3 SMARTSDR AUDIO INPUT CONFIGURATION

As noted previously, the audio input on the ACC Connector is being used for this example.

- **Select the ACC input from the Audio Input dropdown box selection**. In the Transmit control panel, select the ACC input. When this option is selected the **+ACC** button will illuminate.
- **Turn off all audio processing**. Click on the **PROC** and **EQ ON** buttons until they both are not illuminated.

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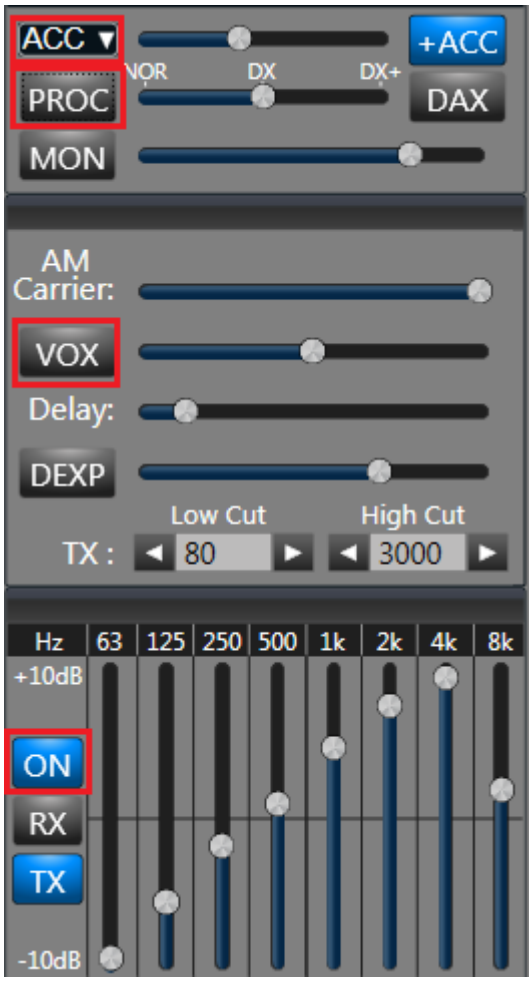
- **Turn off VOX**. Click on the **VOX** button until it is no longer illuminated. The SmartSDR Transmit Control Panel should like the following image below.



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When using the ACC audio input, which is set at a fixed gain level, the adjustment input must be done on the Windows sound card audio control panel or by using controls in the digital mode program itself if they exist. The more common method of adjusting the input gain is by using the Windows audio Control panel.

25.3 DIGITAL MODE PROGRAM SETUP – FLDIGI

With most digital mode programs, you have to configure the audio setup and CAT and Fldigi is no different. For this example CAT will be configured First and then the audio setup.

NOTE: For the remainder of this example it is assumed that you have Fldigi downloaded and installed on your computer. The download URL is: http://www.w1hkj.com/download.html

The **SmartSDR.xml** RigCAT file is also needed. It can be downloaded by doing a right click and a "save as" on it from http://www.w1hkj.com/xmlarchives.html

Please review the Fldigi user documentation for installation instructions.

25.3.1 Fldigi RigCAT Configuration Steps

- Start Fldigi and open the **Configure** Menu
- Select the **Rig Control** menu option
- Click on the **RigCAT** tab
- Check the **Use RigCAT** checkbox
- Click on the **Open** button and select the **SmartSDR.xml** file downloaded previously.
- In the **Device** drop down, select the FlexRadio virtual com port associated with your FLEX-6000. In this example, it is **COM4** the default FlexRadio virtual com port.
- Change the **Baud Rate** to **9600**
- Change the **Stopbits** to **1**
- Make sure the **CAT command for PTT** option is checked
- Click on the **Initialize** button to make the connection to the FLEX-6000. If the connection is successful the **QSY** button on the bottom right hand side of the Fldigi console will no longer be grayed out and the frequency readout for Slice A will be shown above the mode and Filter buttons on the Fldigi console.
- Click on the **SAVE** button to save the configuration changes

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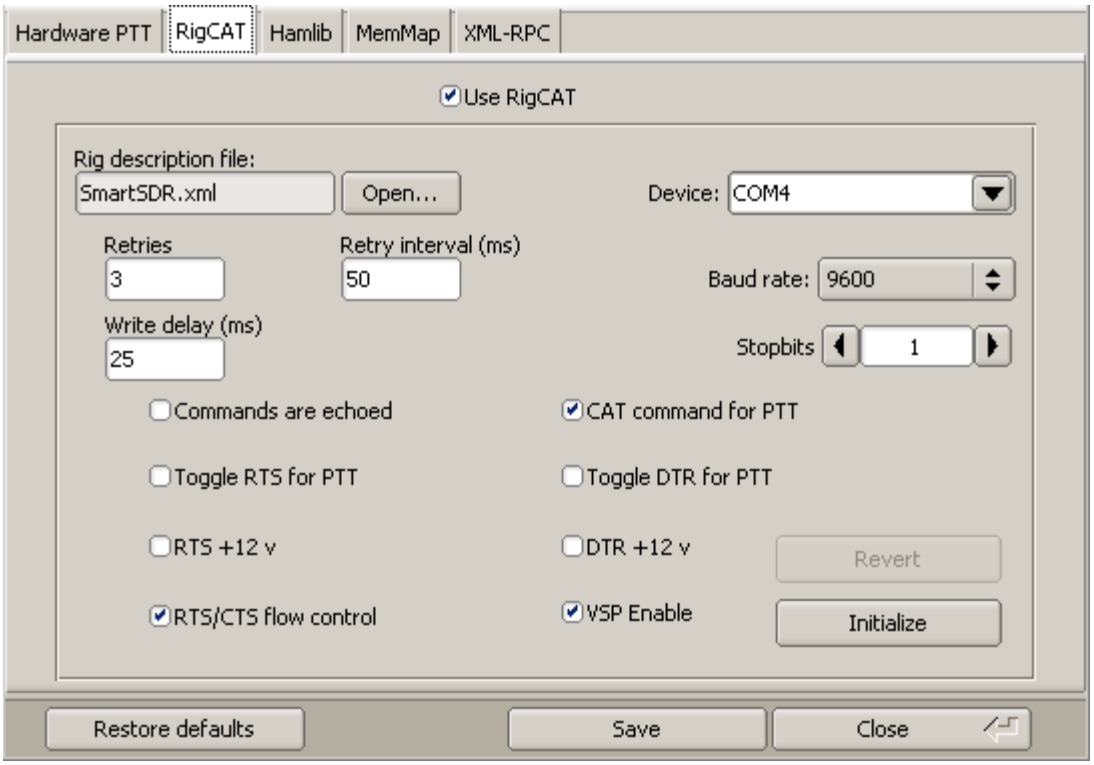

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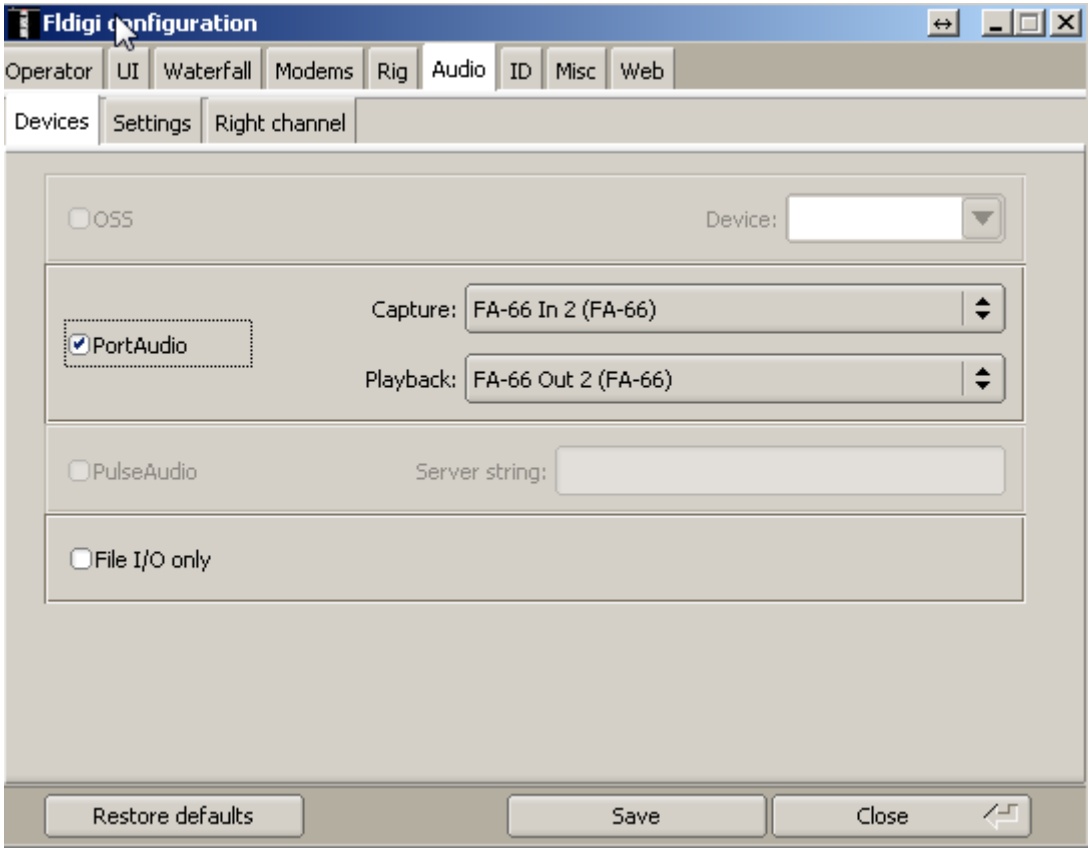
25.3.2 FLDIGI RIGCAT CONFIGURATION STEPS

- Start Fldigi and open the **Configure** Menu
- Select the **Sound Card** menu option
- Click on the **Devices** tab
- Check the **PortAudio** option
- In the **Capture** dropdown box, select the PC sound card **INPUT** interface
- In the **Playback** dropdown box, select the PC sound card **OUTPUT** interface
- Click on the **SAVE** button to save the configuration changes



25.3.3 Adjusting the Audio Gain Levels

As noted previously set the input and output gain controls using the Windows Audio Control panel for the PC sound card.

For the transmit level setting, adjust the digital mode program's output gain until the peak hold bar registers 0 dB on the SmartSDR for Windows Audio Input Level meter as shown below.

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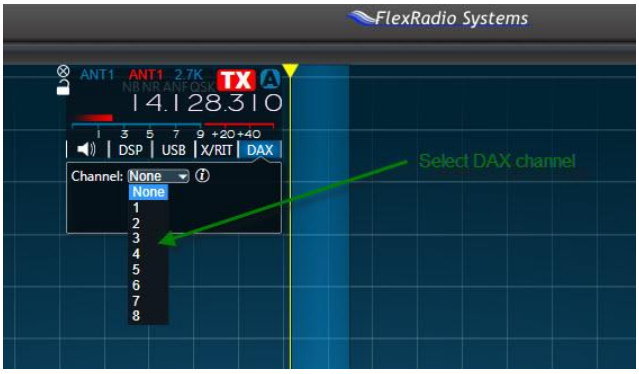
26 DIGITAL MODE SETUP WITH DAX (DIGITAL AUDIO EXCHANGE)

26.1 AUDIO DATA

Audio data will allow you to exchange several kHz of audio data with a receiving program. It is designed to provide you with the audio from a slice receiver so the limits on the slice receiver bandpass filter will set the limits on this audio passband. The Audio support is bi-directional meaning you can both RX and TX. DAX supports up to 8-cannels in the radio.

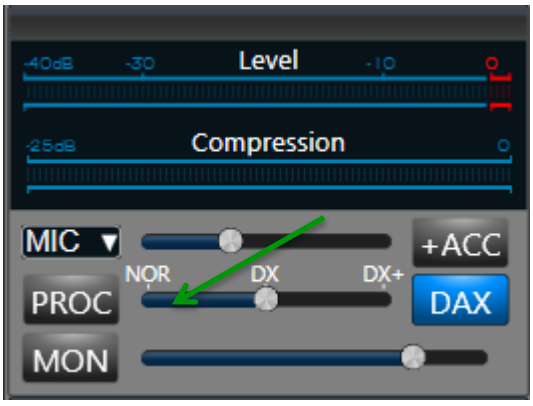
26.1.1 Set Audio Channel on Slice

First select one of 8 DAX channels in SmartSDR on a slice receiver. Each channel can be on only one slice receiver. The radio prevents selection of multiple slices per channel. The selection is made in the DAX panel and associated drop-down:



26.1.2 Set Audio Source

If you intend to use DAX audio for transmit, select DAX as the input source for the audio in SmartSDR



Note that the previous source that you had selected for audio will be used in situations where you initiate PTT with the front MIC or RCA jack on the back of the radio and you are in SSB, AM, FM, SAM.

26.1.3 DAX Panel Setup

Find the DAX icon in the Windows System Tray located in the right corner of your Windows task bar. Right click on the icon and select Show to bring up the DAX Control Panel.

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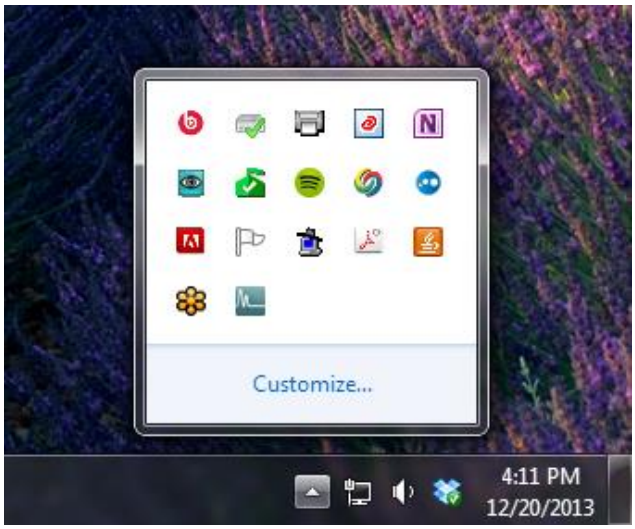

The DAX Control Panel will show you which slice is connected to the channel, the data rate it is receiving from the radio (for diagnostics) and provide a VU meter to see the audio level (again, for diagnostics). You can also select if a particular DAX channel is enabled for transmit on your computer by pressing a TX button in DAX. To receive on a DAX channel, press the channel number and it will turn blue.

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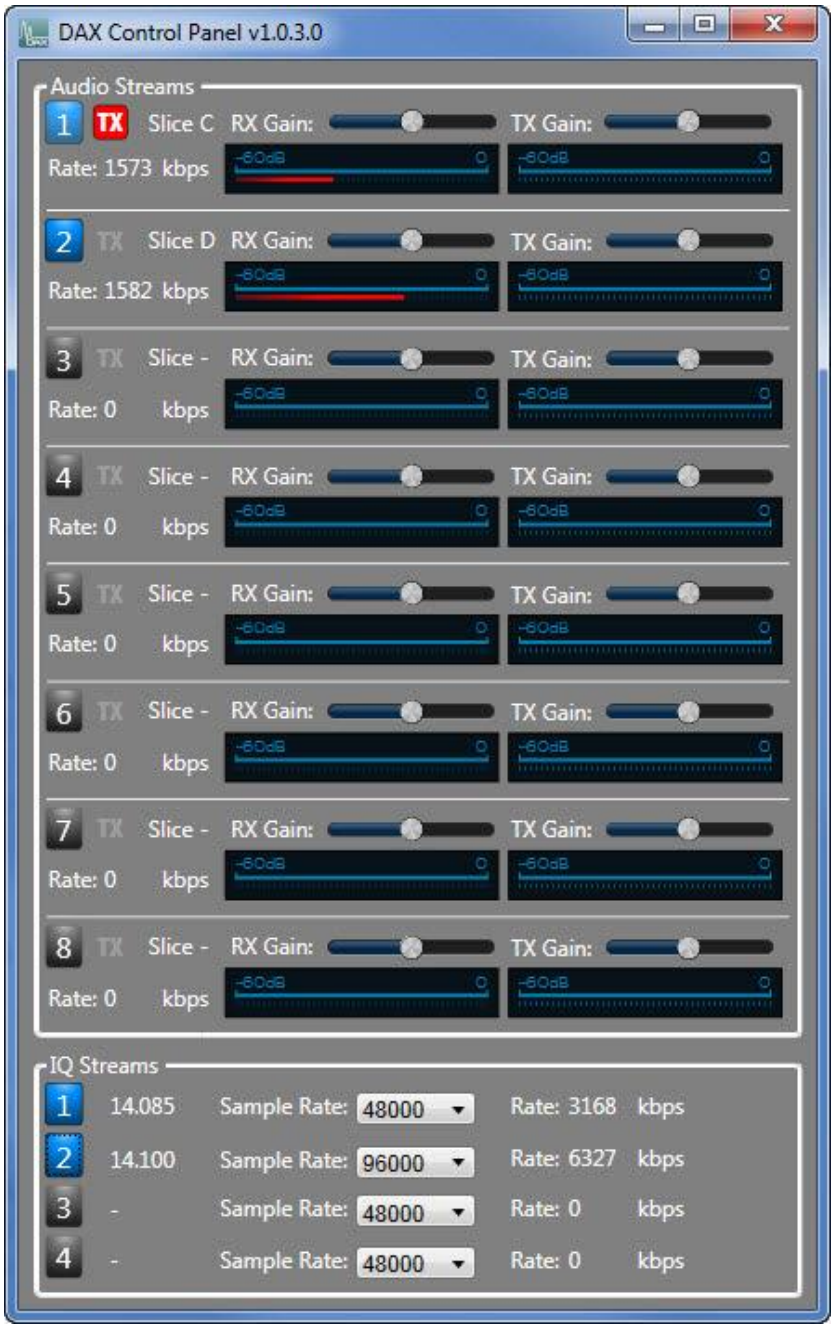
DAX Control Panel v1.0.3.0
Audio Streams
1 TX Slice C RX Gain: TX Gain:
Rate: 1573 kbps
2 TX Slice D RX Gain: TX Gain:
Rate: 1582 kbps
3 TX Slice - RX Gain: TX Gain:
Rate: 0 kbps
4 TX Slice - RX Gain: TX Gain:
Rate: 0 kbps
5 TX Slice - RX Gain: TX Gain:
Rate: 0 kbps
6 TX Slice - RX Gain: TX Gain:
Rate: 0 kbps
7 TX Slice - RX Gain: TX Gain:
Rate: 0 kbps
8 TX Slice - RX Gain: TX Gain:
Rate: 0 kbps
IQ Streams
1 14.085 Sample Rate: 48000 Rate: 3168 kbps
2 14.100 Sample Rate: 96000 Rate: 6327 kbps
3 - Sample Rate: 48000 Rate: 0 kbps
4 - Sample Rate: 48000 Rate: 0 kbps

When the DAX Channel is set for a Slice Receiver, the DAX Control Panel(s) connected to the radio will also show the Slice Receiver that is connected to the DAX Channel as confirmation. When transmit is initiated by a digital mode program through CAT or other means, SmartSDR must make a determination about where the transmit audio will originate. First, the Slice Receiver that has been designated the transmitter in SmartSDR (red TX button on the Slice Receiver flag is illuminated) will be the Slice Receiver transmitting, as usual. If the DAX button is enabled in SmartSDR (in the transmit control panel), DAX will use the DAX source for the transmit audio. If a single DAX Control Panel is active and a single PC is being used, the transmit audio will come from the digital mode program connected to the DAX TX audio sound card corresponding to the DAX Channel of the Transmit Slice Receiver. For example, if the Transmit Slice has DAX Channel 1 selected, audio will originate from the sound card labelled DAX TX 1. Note that in the DAX Control

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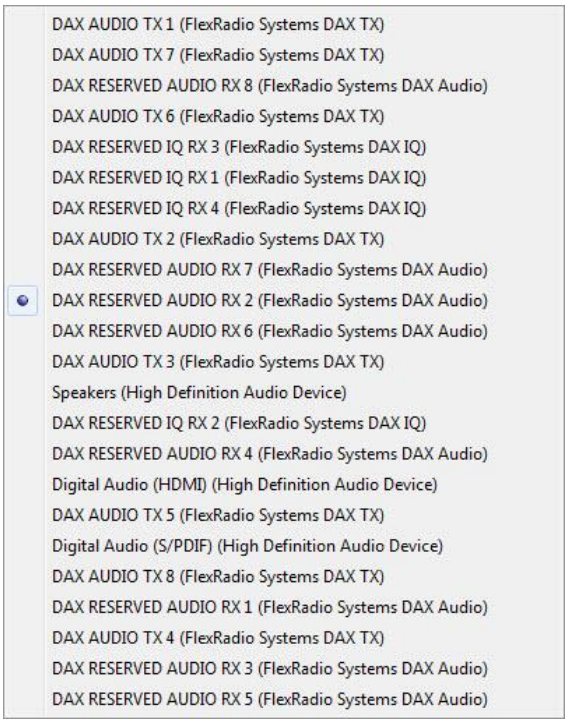
Panel, the TX button to the right of the DAX Channel button must be illuminated in order for this audio to be used.

DAX will allow multiple PCs to use the same DAX channel(s). For example, you could use two PCs to listen to the same frequency with different decoding programs. In the event that more than one PC is used on the same DAX channel, the TX selection in the DAX Control Panel will determine which PC using DAX will be the source of the transmit audio. If you select TX in one DAX control panel for a given DAX Channel, all other PCs will be deselected as the transmit audio source for that DAX Channel.
You can also see the data rate from the radio to the computer and the level being received from the radio listed in kbps while in transmit.

26.1.4 Connecting 3rd party software

Next, connect your 3rd party software to the preset sound cards that are available on your system. Here is an example of a partial list of sound cards:


DAX AUDIO TX 1 (FlexRadio Systems DAX TX)
DAX AUDIO TX 7 (FlexRadio Systems DAX TX)
DAX RESERVED AUDIO RX 8 (FlexRadio Systems DAX Audio)
DAX AUDIO TX 6 (FlexRadio Systems DAX TX)
DAX RESERVED IQ RX 3 (FlexRadio Systems DAX IQ)
DAX RESERVED IQ RX 1 (FlexRadio Systems DAX IQ)
DAX RESERVED IQ RX 4 (FlexRadio Systems DAX IQ)
DAX AUDIO TX 2 (FlexRadio Systems DAX TX)
DAX RESERVED AUDIO RX 7 (FlexRadio Systems DAX Audio)
DAX RESERVED AUDIO RX 2 (FlexRadio Systems DAX Audio)
DAX RESERVED AUDIO RX 6 (FlexRadio Systems DAX Audio)
DAX AUDIO TX 3 (FlexRadio Systems DAX TX)
Speakers (High Definition Audio Device)
DAX RESERVED IQ RX 2 (FlexRadio Systems DAX IQ)
DAX RESERVED AUDIO RX 4 (FlexRadio Systems DAX Audio)
Digital Audio (HDMI) (High Definition Audio Device)
DAX AUDIO TX 5 (FlexRadio Systems DAX TX)
Digital Audio (S/PDIF) (High Definition Audio Device)
DAX AUDIO TX 8 (FlexRadio Systems DAX TX)
DAX RESERVED AUDIO RX 1 (FlexRadio Systems DAX Audio)
DAX AUDIO TX 4 (FlexRadio Systems DAX TX)
DAX RESERVED AUDIO RX 3 (FlexRadio Systems DAX Audio)
DAX RESERVED AUDIO RX 5 (FlexRadio Systems DAX Audio)

For each DAX Audio channel, you will see four sound cards. Let's assume we're looking at DAX Channel #1:

- DAX AUDIO RX 1
- DAX AUDIO TX 1
- DAX RESERVED AUDIO RX 1
- DAX RESERVED AUDIO TX 1

You will connect your 3rd party software to the DAX AUDIO RX/TX sound cards. The ones marked RESERVED are for internal use in the software so you should not connect to them.

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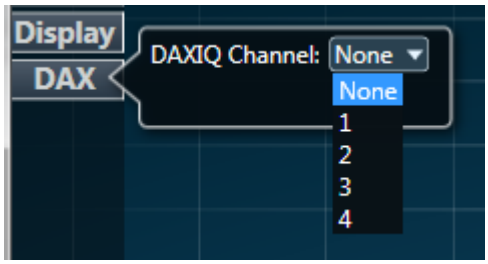
26.2 DAX IQ DATA

The second type of DAX channel, listed in the lower portion of the DAX Control Panel is the DAXIQ channel, of which there are four (all four may not be implemented on all radios). Each of these channels will stream wide-band IQ data to a client program. This allows decoding of multiple signals across large swaths of the amateur bands. The data provided in a DAXIQ channel is "raw I/Q" which has no demodulation, AGC, etc. applied to it. This is similar to getting a RAW file out of a digital camera instead of a JPG file.

26.2.1 DAXIQ Channel

First select one of four DAXIQ channels from the DAX menu on the panadapter. Each channel can be on only one panadapter. The radio prevents selection of multiple panadapters per channel.



26.2.2 DAX Panel Setup

On the DAX Panel, enable the stream that corresponds to the channel set in the SmartSDR Panadapter by clicking on the number. When enabled, the button will change to blue. Here you also can see the center frequency of the panadapter, set the sampling rate of the stream as well as see the transfer rate in kbps.

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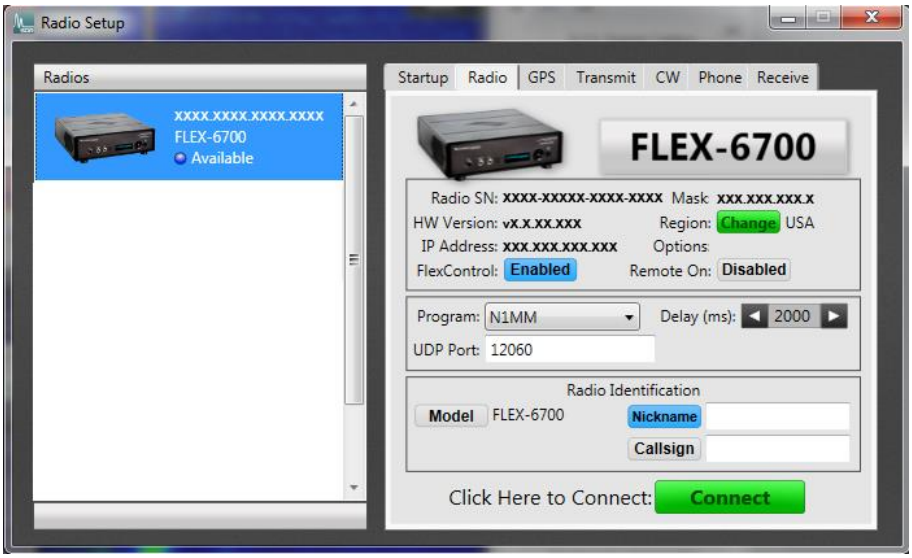
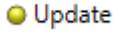
27 RADIO SETUP

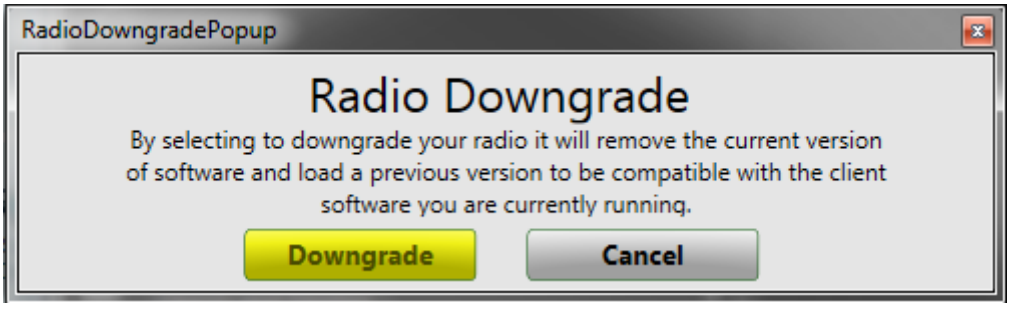


27.1 INTRODUCTION

After installation of the SmartSDR software you will find an icon on your computer desktop to launch SmartSDR. Double click the icon to launch the program. Upon launching SmartSDR, you will be presented with the Radio Setup window. The Radio Setup window is where you will select and configure the radio you wish to connect to.

27.2 UPDATING A RADIO

In the event where the current Radio Hardware version is not compatible with the current Client Software version, an update will be required. You will notice that there is a yellow indicator  followed by the text "Update" in the list box where your radio is listed. You will also notice text requiring you to update your radio before you can proceed. In order to resolve the discrepancy, click . As long as your radio is advancing to a more recent revision it will begin the update process. If the Client Software requires an older Radio Hardware version, a pop up window will be shown to ensure that this is being done intentionally.


RadioDowngradePopup
Radio Downgrade
By selecting to downgrade your radio it will remove the current version of software and load a previous version to be compatible with the client software you are currently running.
Downgrade
Cancel

Clicking the Downgrade button will remove the current version of software and load a previous older version to be compatible with the client software you are currently running. Click to proceed. Click to maintain the existing version of Radio Hardware.

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(Note: If you were not intending to downgrade the radio, check to make sure that you are running the correct version of SmartSDR.)

Once the process has started you will see a progress bar showing the approximate completion status. Upon completion of the update you will see Available appear next to the radio in the list box.

27.3 CONFIGURING A RADIO

In order to configure a radio, select the radio you wish to connect to in the list box located on the left side of the Radio Setup window. Once selected, the radio will be highlighted in blue. Use the tabs toward the top of the window to navigate to the different areas for configuration.

27.4 STARTUP TAB

Located in the "Startup" tab are quick troubleshooting tips for connecting to your radio. You will also find the Client Software Version as well as the GPU Capability of your computer. Client Software version refers to the SmartSDR for Windows software that runs on your computer.

Startup
Radio
Transmit
CW
Phone
Receive
XVTR
SmartSDR
Select radio on the left to begin!
If your radio is not displayed please try the following troubleshooting tips:
1. Make sure your radio is turned on and connected to the network. Make sure the front panel and Ethernet LEDs are illuminating on the radio.
2. Check your computer's network connection. Look for LEDs on the computer's Ethernet connector.
3. For assistance: HelpDesk or the Online Community.
SmartSDR Versions:
Client Software: v1.2.22.27063
GPU Capability: Maximum Graphics Acceleration

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27.5 RADIO TAB

Located in the "General" tab is basic information about the selected radio. The tab contains the Radio Hardware version, Installed Options, Hardware Version, Mask (subnet mask) and IP Address of the radio. Radio Hardware version refers to the software and firmware that is loaded into the radio itself.

Following the "Mask" is a "Region" indicator which displays the country for which the radios transmit capabilities are based. The Change button will open an explorer window to select a TURF file for changing the region. (A TURF file is supplied by FlexRadio Systems or the international distributor where the radio was purchased) Navigate to the TURF file and click "Open". The radio will automatically update the radio to the new region.

There is an option to enable/disable the FlexControl by clicking the Enabled. When blue the FlexControl is enabled, when grey Disabled the FlexControl is disabled and will no longer control SmartSDR.

Next is the Remote On enable/disable control Enabled. When blue Remote On is enabled, when grey Disabled remote on is disabled. To operate remote on, with the radio off, if you close the rear RCA connector continuously, it will power on the radio. Open the RCA contact and the radio will power off.

The next section contains controls for adjusting focus integration controls. This allows the user to pass the mouse and keyboard focus back to the third party program of their choice. The delay control adjusts the wait time for SmartSDR to pass the focus back to the selected program. When "N1MM" is selected in the dropdown menu a textbox becomes available to adjust the UDP Port which is the

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receiving port for N1MM. Modification of the N1MM ini file is required and must agree with this port number. See the link below for more details on setting up N1MM to broadcast the focus data: http://n1mm.hamdocs.com/tiki-index.php?page=UDP+Broadcasts

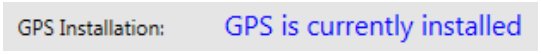
When "Other" is selected from the dropdown menu then a textbox becomes available to adjust the name of the window that will be receiving the focus.

In the Radio Identification section there are three modes for identifying your radio, Nickname, Callsign and Model. After entering in a Nickname or Callsign, clicking the buttons beside the text will cause the corresponding information to appear in the OLED display on the front of the radio. When the selected option is active the button beside it will illuminate blue. For example the Model button

is enabled displaying "FLEX-6700" on the OLED display. [NOTE: You must connect to the radio before you can set the display]

27.6 GPS TAB

(Only available on the FLEX-6700 and FLEX-6500) The "GPS" tab has the option to Install or Uninstall a GPS module in the software. If your radio has a GPS module installed from the factory, this process should already be complete. If you are installing the GPS module after the fact you will need to click

to test for the GPS and enable the GPS functionality. If the installation has been successful you will see: 

toward the top of the panel. When removing the GPS or if you would like to bypass the GPS you will click

to disable GPS functionality.

The lower portion of the GPS tab displays information collected from the GPS module. This information includes:

1. Latitude
2. Longitude
3. Grid Square
4. Altitude
5. Sat Tracked - Number of Satellites being tracked by the GPS
6. Sat Visible - Total number of satellites that should be visible to the GPS currently
7. Speed - Speed of your radio in knots along the surface of the Earth
8. Freq Error - Average error in the frequency of the 10MHz output from the GPS. If you multiply this number by your current frequency, it is the GPS's report of how far off frequency you could be.
9. Status - Displays the current status of the GPS Module. One of six modes will be displayed:

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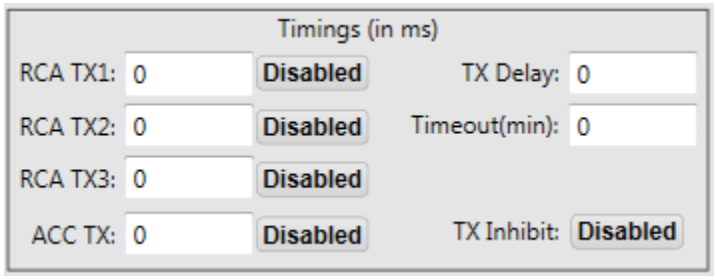
a. Not Present
b. Holdover
c. Locking
d. Locked
e. Holdphase
f. Warm up

10. UTC Time

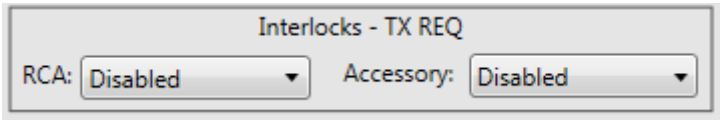
27.7 TRANSMIT TAB

The "Transmit" tab offers adjustments for Timings as well as Interlocks.

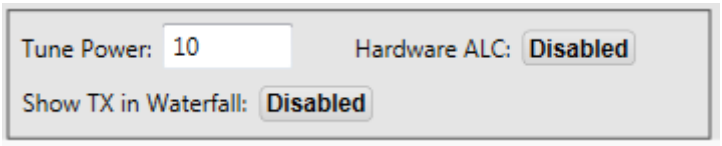


The "Timings" section has adjustments for RCA TX1, TX2 and TX3 (Only TX1 on FLEX-6300) as well as the Accessory TX, TX Delay and TX Timeout. Each of these controls is measured in Milliseconds (MS). Each of the TX1, 2, 3 timings are independent and start from depressing the microphone PTT, keying of a cw paddle, etc. RF can come out as soon as the largest of TX1, 2, 3, ACC_TX have elapsed if TX_Delay is set to zero. Otherwise TX_Delay is added to the maximum of TX1, 2, 3, ACC_TX. The user can also enable/disable the TX Inhibit by clicking on the

button.

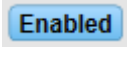


The "Interlocks" section offers three setting for RCA TX and Accessory TX: Disabled, Active High and Active Low. The FLEX-6300 does not have interlock settings for RCA.



The "Tune Power" text box allows the user to manually set the Tune Power from 0 - 100 Watts.

The user can also enable/disable the Hardware ALC by clicking on

. When blue 

Hardware ALC is enabled, when grey it is Disabled.

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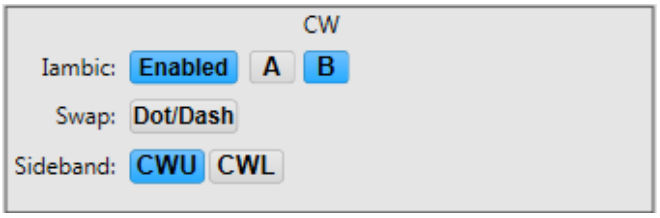
Δ – Please note this input is provided as a safety measure for external amplifiers. It is NOT meant to be used in regular operation as an active power control input or to modify the "attack" of an external amplifier. Almost all modern HF amplifier manufacturers discourage the use of ALC in normal operation. In fact, many amplifiers do not have ALC implemented.

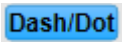
The software is set to not show your transmit signal on the waterfall by default so that the waterfall does not display data that may not be useful to the user. Instead it will display a single white line while in transmit. When enabled, The Show TX in Waterfall setting will cause the waterfall to show the data of your transmission.

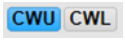
27.8 CW TAB



Under the CW tab there is a slider to toggle Iambic mode and paddle swap for dot/dash. Iambic can be enabled or disabled in either mode A or mode B configurations. Blue signifies selected mode

.

There are two settings for the Key configuration, Dot/Dash and Dash/Dot. Dot/Dash indicates the left paddle is the dot and the right is the dash. When Dash/Dot is selected the button will highlight blue 

There is also a selection for upper (CWU) or lower sideband (CWL) for CW Operation. 

27.9 PHONE TAB

On the SSB Tab there are controls for setting up Microphones as well as Transmit Filter Bandwidths.

BIAS button: Clicking this button will enable the +5 VDC microphone BIAS voltage on the MIC connector. Only enable the BIAS if the microphone being g used requires the +5 VDC voltage to operate, such as microphones with condenser elements.

+20dB button: Clicking this button will enable the +20 dB gain audio preamp. This option is not available when LINE is selected as the audio input.

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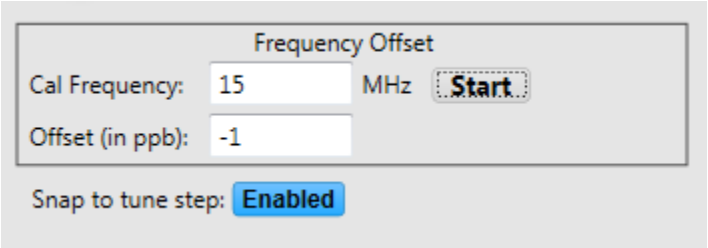
Disable/Enable Mic Meter button: Enables or disables the Mic Meter during receive.

27.10 RECEIVE TAB

The receive tab has selections for Frequency Offset to adjust for the error in the local oscillator.



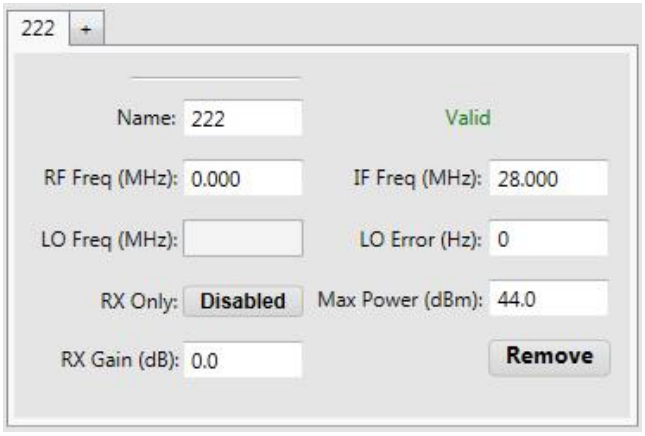
Calibration Frequency: This is the frequency of the source that you are using for the calibration.

Start: Initiates the automatic estimation of the offset based your cal frequency.

Offset: Resulting offset in parts per billion. This box can also be manually entered.

The Snap to tune step feature will allow the user to adjust whether features like Drag Tune or Click Tune will snap (or round the frequency) to the closest tune step size. For example, if your tune step is set to 10Hz then the slice receiver will snap to every round 10hz (ie. 14.100.000, 14.100.010, 14.100.020) increment regardless of the tuning method. When this feature is disabled it will allow the receiver to be tuned in 1hz steps.

27.11 XVTR TAB



The XVTR Tab allows the user to set up transverter bands for the FLEX-6000. Clicking the '+' will create a new tab for a new transverter band. Each band can be set with a low and high limit frequency listed in MHz. It also allows the user to set the Intermediate Frequency (IF) and the IF Offset to correct for the error in the transverter's oscillator. The Max power can now be modified from -10 to +15 dBm (below 80MHz, -10 to +8 dBm above). The user can also Enable or Disable transmit for each transverter band. The RX Gain is an offset to compensate for receive gain in the transverter hardware so that the panadapter and meter data appear correctly. Clicking the Delete button will delete the selected band.

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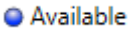
27.12 CONNECTING TO A RADIO

In order to connect to a radio, select the radio you wish to connect to in the list box located on the left side of the Radio Setup window. If you are able to connect to the radio, you will see 

appear next to the radio in the list box. Once selected, the radio will be highlighted in blue. Click

or double click on the radio in the list box to initiate the connection. This will close the Radio Setup window and open the Main Window of SmartSDR.

- Main Window
  - Upper Menu Bar
    - Menu's
    - Volume
  - Lower Menu Bar
    - Buttons
    - Time
    - TX indicator
  - Organization and arrangement
    - Tile adjustments

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27.13 RESTORING TO FACTORY DEFAULTS

Restoring the radio to factory defaults will clear any persistence data in the radio and return it back to its original state.

NOTE: This should only be used as a last resort. If you are having trouble with your radio, please submit a HelpDesk support request.

On the FLEX-6500 or FLEX-6700, to restore to factory defaults hold down the "OK" button on the front panel of the radio while you press the power button. On the FLEX-6300, hold down the power button until the LED blinks purple. This will clear any memories in the radio and return them back to their original state. NOTE: This should only be used as a last resort. Contact support if you are having trouble with your radio.

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28 MAIN WINDOW

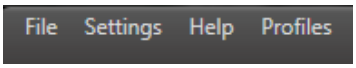
28.1 INTRODUCTION

The Main Window of SmartSDR is where the primary operation of the radio will occur. Inside this window there is a Top Menu Bar, Bottom Menu Bar, and Tiles.

28.2 UPPER MENU BAR

Located in the top menu bar are a series of drop down menus "File", "Settings" and "Help". You will also find volume controls for speaker and headphone volume.

28.2.1 Menus



- "File" Menu contains the following selections:
  - "Exit" - Selecting this option will close SmartSDR and disconnect from the radio.
  - "Import/Export" – Selecting this option will open the Import/Export control window for exporting or importing the radio settings.
- "Settings" Menu contains the following selections:
  - "Radio Setup" - Selecting this option will bring up the Radio Setup Window for connecting and configuring radios.
  - "FlexControl" – Selecting this option will bring up the FlexControl Setup Window for modifying the programmable functions of the FlexControl.
- "Help" Menu contains the following selections:
  - "Support" - Selecting this option will launch your default web browser and navigate to the FlexRadio help desk (http://helpdesk.flexradio.com/home). Here you can find information about troubleshooting your radio or submit a ticket to receive support.
  - "Community" – Selecting this option will launch your default web browser and navigate to the FlexRadio support community (http://community.flexradio.com/home). Here FlexRadio users can post questions/answers, ideas, problems and praises so that other users can comment and offer support to one another.
  - "Tutorial" – Selecting this option will bring up the "Tips and Tricks" tutorial window which provides helpful hints on how to operate SmartSdr.
- "Profiles" Menu contains the following selections:
  - "Save Global Profile" – Selecting this option will bring up the Profile Manager window to save all of SmartSDR's current settings into a single Global Profile that can be selected from a list of profiles.
  - "Save Transmit Profile" – Selecting this option will also bring up the Profile Manager window to save the current Transmit settings in to a single Transmit Profile that can be selected from a list of profiles.
  - "Profile Manager" – Selecting this window will reveal the Profile Manager window to create, delete or modify profiles.

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- Once Global profiles are created they will be listed below for quick selection.

28.2.2 Volume Controls

In this section there are two rows of controls. The first row controls the speaker volume for the radio's powered speakers. By clicking you will mute the audio of any speakers connected to the PWR SPKR plug. After muting, the icon will show a red circle with a cross through it . Located to the right of this button is the Speaker Volume slider . Adjusting the silver circle to the left or to the right will decrease or increase respectively your speaker volume. The Headphone Volume controls behave the same way as the icon will display when muted. Likewise with the Headphone Volume slider will adjust the volume of any headphones connected to the radio.

28.3 LOWER MENU BAR

Located in the Lower Menu bar you will find a series of controls for initiating items within SmartSDR. You will also find a Transmit indicator and a Date/Time indicator.

28.3.1 Application Launcher

In the application launcher you will find a series of controls which will initiate applications within the SmartSDR infrastructure.

- The first control will add another Panadapter to the Main Window. This control will turn to a dark shade of grey when you have used up the available panadapter resources.
- The second control will launch or hide the Transmit Control Panel. This panel will appear vertically on the right side of the Main Window of SmartSDR. Once the Transmit Panel is opened it can be closed by clicking the icon again.
- The third control will globally toggle on and off the Tracking Notch Filters that have been placed. When disabled, the TNF(s) will turn to a shade of white on the panadapter.
- The fourth control will launch or hide the CWX panel. This panel will appear vertically on the left side of the Main Window of SmartSDR. Once the CWX Panel is opened it can be closed by clicking the icon again

28.3.2 GPS Indicator

- FLASHING YELLOW = GPS in warm up

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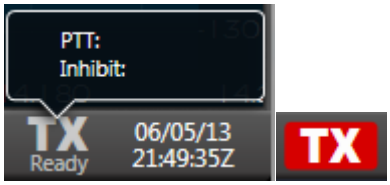
- SOLID YELLOW = GPS in holdover (lost satellites)
- SHORT FLASH BLUE = GPS locking
- LONG FLASH BLUE = GPS in hold phase mode
- SOLID BLUE = GPS locked
- SOLID AMBER = Radio off, GPS powered for stability

28.3.3 Transmit Indicator

The Transmit indicator

is designed to inform the user of the current state of the radio transmitter. The smaller text below the "TX" describes the status of the transmitter.



28.3.4 Date/Time Indicator

The Date/Time Indicator gathers data from your computer's clock. Today's date is listed on the first line and the current time in Greenwich Mean Time (GMT) on a 24 hour scale is on the second line.

28.4 ORGANIZATION AND ARRANGEMENT

In this section we will discuss the organization and arrangement of the Main Window of SmartSDR. This will include the organization of the Tiles within the window as they resize and reorder with user input.

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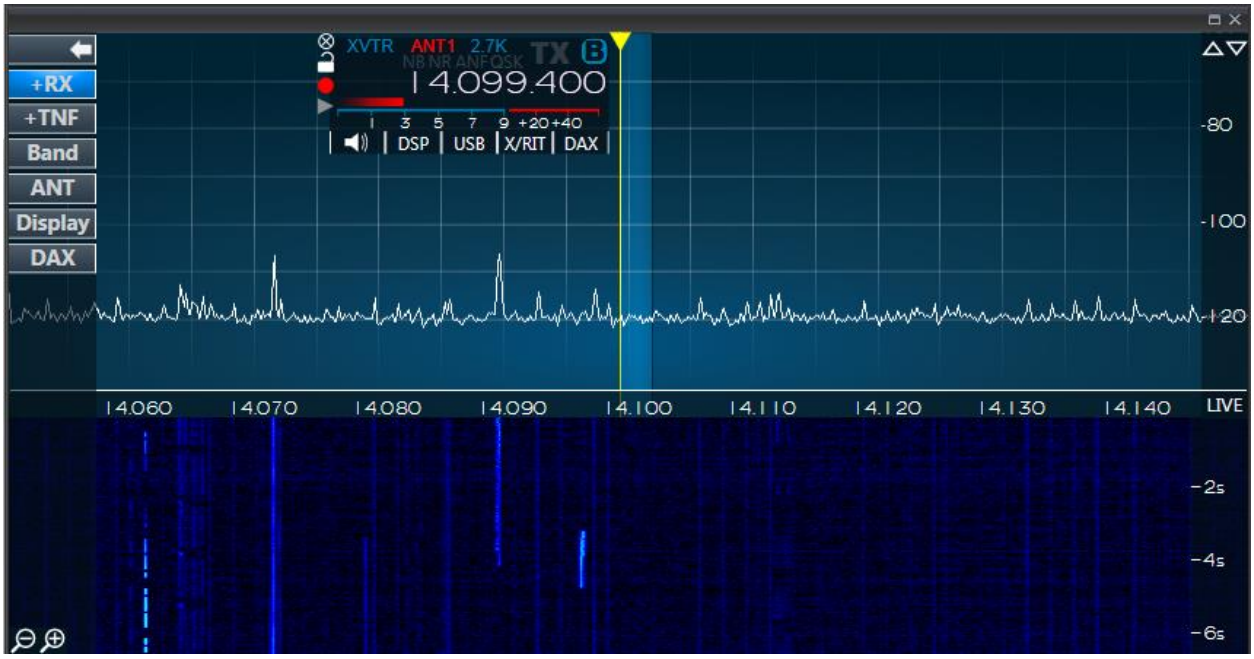
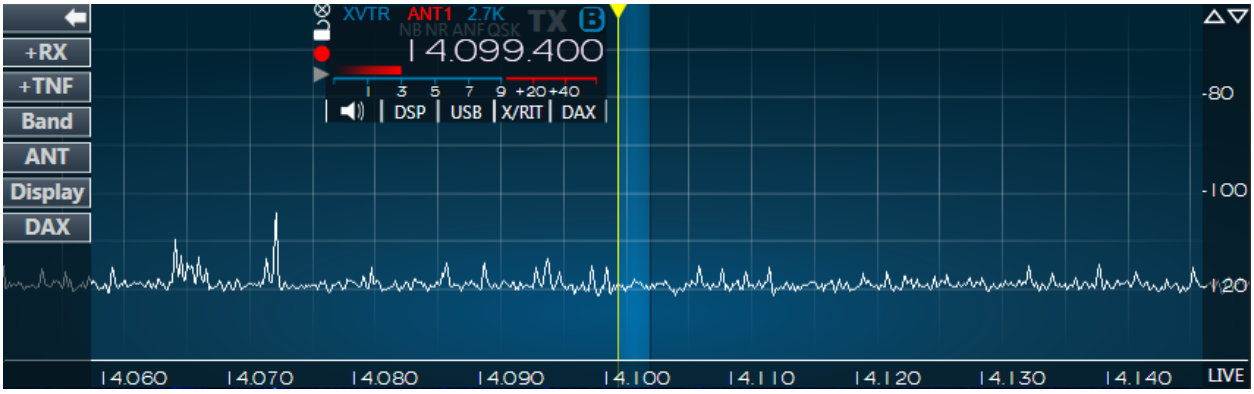
28.5 PANAFALL (PANADAPTER/WATERFALL)



28.5.1 Panadapter Definition



A Panadapter is a visual spectrum display of radio frequencies (RF). Frequency is listed along the horizontal axis from lower to higher frequency, from left to right, measured in Megahertz (MHz). Amplitude is shown on the vertical axis measured in decibels (dB). The moving white line represents RF coming into the radio. The panadapter is where the majority of typical operation will occur. The FLEX-6000 series radios are capable of displaying multiple panadapters simultaneously each with their own frequency and bandwidth.

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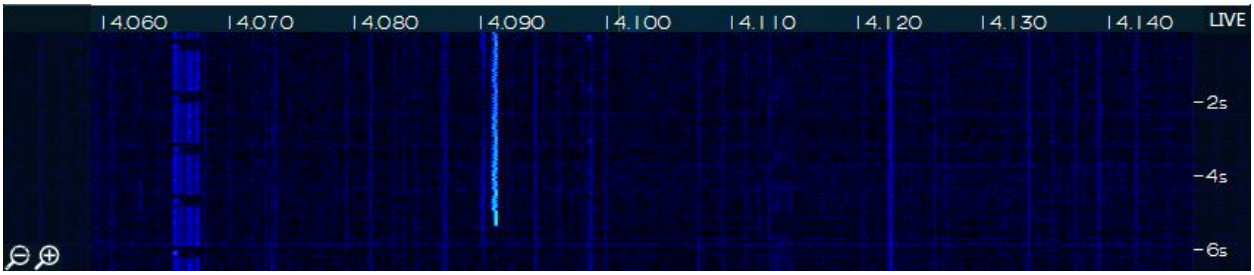
28.5.2 Waterfall Definition



A Waterfall is a historical representation of the frequency data over time. Frequency is listed along the horizontal axis from lower to higher frequency, from left to right, measured in Megahertz (MHz). Time is listed on the vertical axis where the most recent data is at the top and the oldest data is on the bottom.

28.5.3 Left Menu

In this section there are a series of menu options that control various functions of the panadapter. These controls are located on the left side of the panadapter.

- Hide Menu button will collapse the panadapter menu so that it is no longer obstructing the view of the panadapter. When clicked it will appear with an arrow pointing to the right . Clicking the button again will expand the menu back to its default state.
- Add Slice Receiver button will place an additional Slice Receiver resource inside the panadapter. When you have utilized all of your available Slice Receiver resources the Add Slice Receiver button will turn to a dark shade of grey indicating that the action is no longer available. It will return to an available state once a Slice Receiver is closed.
- Add Tracking Notch Filter button will place a TNF in the center of your slice filter. If no slice is available the TNF will be placed at the center of the panadapter.
- Band menu button will expose the Band Menu. Selecting a band from this list will adjust the panadapter display to within the correlating amateur radio band. One band can be selected at a time and allows for rapid switching between views of the amateur radio bands. Clicking the Band menu button again will collapse the menu.

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- When switching between bands, if any Slice Receivers were left on the old frequency, these are removed and one new one will be added. If no Slice Receivers were present, one will not be added at the new frequency.

- Antenna menu button

will expose antenna selection options.

  - The RX ANT

drop down menu allows you to select the antenna that you would like to use for receive within this panadapter. This will dictate which antenna is supplying the RF for the frequency display as well as the receive audio for the Slice Receivers within the panadapter.
  - The Loop buttons

will toggle on (Blue) and off (Grey) the LoopA or LoopB ports. The FLEX-6500 only has one loop option while the FLEX-6300 does not have a loop option.
  - RF Gain
adjusts the preamps of the FLEX-6000. The FLEX-6700 has two stages of hardware preamps which allow a total of five Preamp settings in 10dB steps (-10, 0, +10, +20, +30). In most scenarios, the preamp should be left in the default setting for optimal operation. In a few rare situations (e.g. extremely low RF noise floor, lossy receive antenna), you may get a bump in signal to noise ratio by turning the preamp up. Even rarer, if you had extremely strong signals, you may decrease the preamp setting to keep from overloading the radio RF front end. The FLEX-6500 has one hardware preamp and 3 preamp settings while the FLEX-6300 has one hardware preamp and 2 preamp settings.

- Display menu button

on the Panadapter menu will expose display controls. A horizontal line separates panadapter controls (top) from waterfall controls (bottom).

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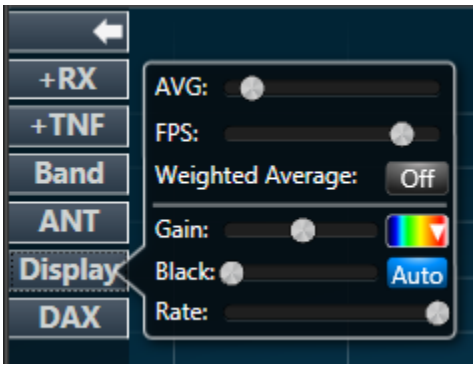

The FPS slider controls the Frames Per Second that the Frequency Line is drawn at. Lowering the FPS control has several effects:

1. It lowers the rate at which both the panadapter and the waterfall are updated
2. It lowers the network bandwidth of data sent from the radio to the client (important in situations where you may have limited bandwidth)
3. As the rate of update is lowered, the extra data not displayed is averaged and so the variance of the data is lowered, making both the panadapter and the waterfall smoother

If you prefer a faster updating display, but a more averaged or smoother one, adjust the FPS setting for the update speed you prefer and then raise the AVG (averaging) control. The AVG control increases the number of frames that are averaged, lowering the variance and smoothing the display.

The final panadapter control, Weighted Average, emphasizes signals that are increasing in amplitude over ones that are declining. This has a tendency to continue to show locations where signals have been and show a more precise view of their full amplitude when they first appear.

Below the line at the center of the control are the Waterfall controls.

The Gain, Black and Auto controls work together to adjust how different signal levels are displayed in the waterfall. The Black control sets the level below which all pixels will render as black. In other words, it sets the level at which signals are no longer of interest. The Auto control will automatically set the black level to just below the noise as band conditions, preamplifier changes or antenna changes alter the noise floor. To enable auto-black, click the Auto button so that it is blue.

The Gain control adjusts how rapidly the waterfall will advance through the color spectrum for minimal changes in signal level. Adjusting gain low gives the waterfall a broader dynamic range, but lessens its ability to show small variations signals. Raising the gain lowers the dynamic range, but provides more detail in the variances in smaller signals' magnitudes.

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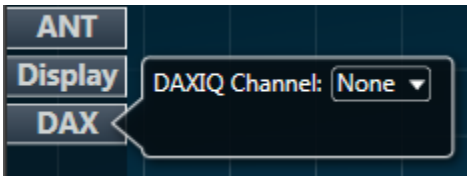
- The DAX menu button

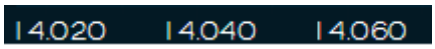
will expose the DAX controls.



  - The DAXIQ Channel dropdown menu allows the user to select the DAX channel (1-4) that will stream the IQ from the panadapter.

28.5.4 Horizontal Zoom

Each panadapter has a zoom range up to a maximum of 14 MHz in bandwidth displayed at one time on the FLEX-6500 and FLEX-6700 and up to 7 MHz on the FLEX-6300. There are multiple methods for adjusting the zoom of the panadapter.

- The first is by the plus and minus buttons located in the bottom left corner of the panadapter and is used for rapid zooming. Zooming out (-) will double the bandwidth presented in the panadapter while zooming in (+) will cut the bandwidth in half. The frequency at the center of the panadapter will remain the same after clicking a zoom button.
- The second method is a click and drag method using the horizontal axis for more precise zooming. 

The click and drag method will zoom in by dragging to the right and vice-versa. With this method the frequency at the point where your mouse was located at the click event will remain stationary in the panadapter.

When zooming out with a FLEX-6000 radio there are certain points where the size of the data used to create the display on the screen will need to be doubled. As this occurs there will be more noise taken into account while processing the display which will cause a noticeable increase in the noise floor. The reverse occurs when zooming in on a panadapter. After zooming out to a certain point, the hardware will switch to wideband mode. When this occurs, any panadapters that are affected by this change will display

in the top right corner to indicate that it is in wideband mode. When in Wideband the radio will open up the Bandpass Filters as wide as they can go for any panadapters or slice receivers that are using that Antenna.

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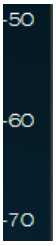
28.5.5 Vertical Zoom

Each panadapter will allow you to adjust the maximum and minimum amplitude displayed. Clicking the up or down arrows displayed in the top right corner of the panadapter will increase or decrease respectively the maximum amplitude displayed in 10 dB increments. You may also adjust the minimum amplitude by clicking and dragging the vertical axis. This will effectively adjust where the noise floor is positioned within the panadapter.



28.5.6 Panning Method

Each panadapter has the ability to perform a pan function to adjust the frequency range that is viewed. Clicking and dragging within the panadapter grid will reorient the frequencies being viewed on the panadapter in the direction that your mouse is moving. By moving your mouse to the right you will display lower frequencies and vice-versa.

28.5.7 Close/Maximize/Rearrange

Clicking the Close button will remove the panadapter and any slices that are displayed in the panadapter. Once this occurs you will not be able to use the slice resources until they are recreated in a new panadapter.

Clicking the Maximize button will prioritize the arrangement of the panadapter at the top of the display. Once a panadapter is maximized a grey horizontal separator will appear between the maximized panadapter and any other panadapters that are open at the time. Clicking and dragging this horizontal separator will increase or decrease the available size for the maximized panadapter. The non-maximized panadapters will adjust to fill the remaining available space. To return to the standard view click the next to the close button. You can have up to three maximized panadapters at a time.

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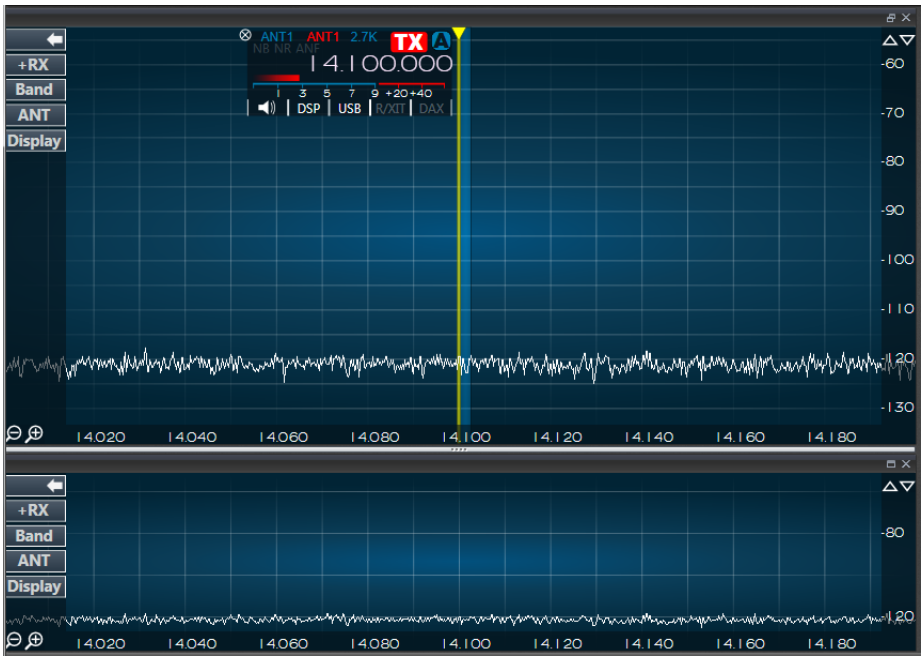

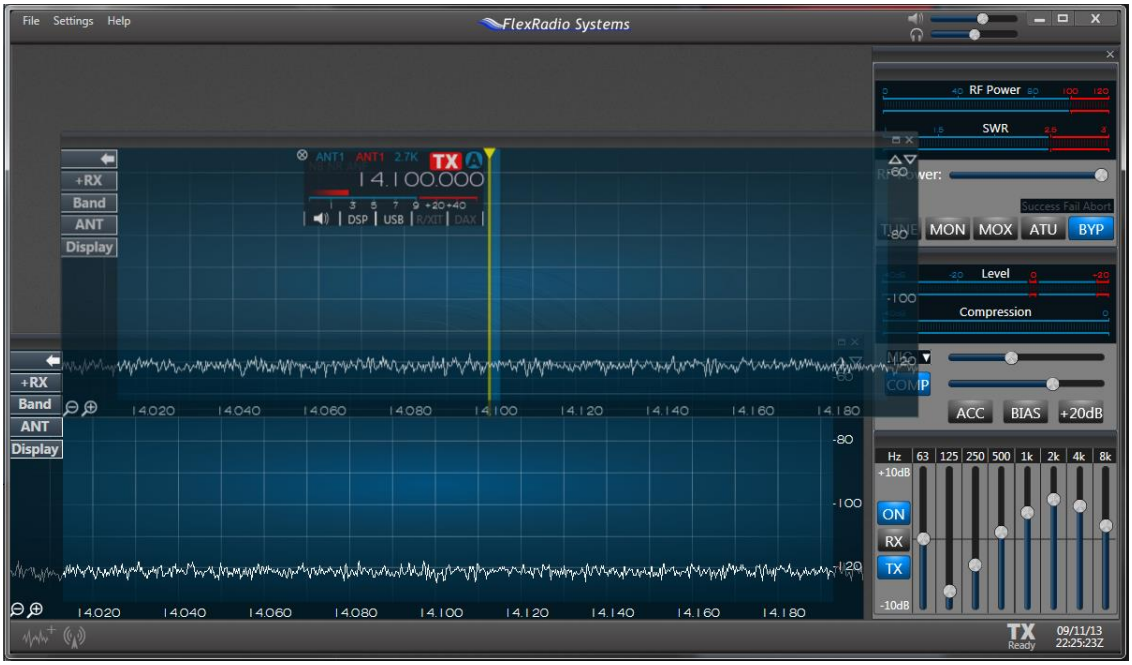

When multiple panadapters are open, clicking on the main bar and dragging its position will rearrange the panadapter windows.

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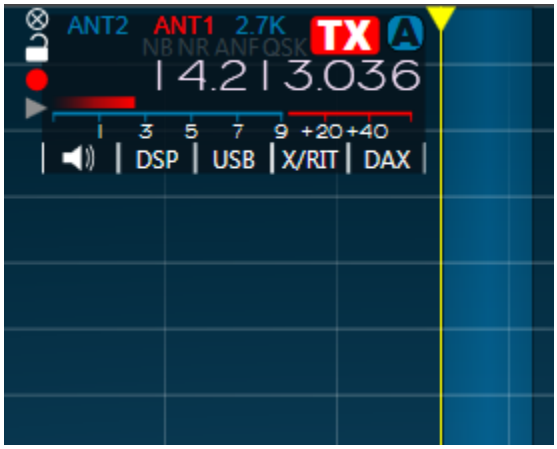
28.6 SLICE



28.6.1 Definition

A Slice is a software resource which represents an independent, full performance, receiver. FLEX-6000 radios can have multiple Slices in operation at one time. A FLEX-6700 can operate up to eight Slices simultaneously while the FLEX-6500 can operate up to four and the FLEX-6300 can operate two. Each Slice is designated by a letter indicator which increments with each additional Slice.

28.6.2 Carrier Frequency

A slice consists of a center Carrier Frequency displayed by a solid yellow or red vertical bar. A yellow bar indicates the slice is "Active", suggesting that this is the slice that you are currently manipulating. An active slice will have the focus of tuning devices such as the mouse wheel and the FlexControl.

28.6.3 Receive Filter

Surrounding the Carrier Frequency bar will be a blue Receive Filter bar which represents the filtered receive audio. The portion of spectrum that is highlighted by the Receive Filter bar will be output as audio.

The position of the Receive Filter relative to the Carrier Frequency will correspond to what mode that you are in. A Receive Filter to the right of the Carrier indicates an Upper Sideband mode. A Receive Filter to the left indicates a Lower Sideband mode. A Receive Filter that spans both the left and right of the Carrier will indicate a double sideband mode.

The Receive Filter width can be adjusted manually by hovering the mouse over the edge of the bar to get the <-> cursor. Clicking and dragging will expand or reduce the size of the filter.

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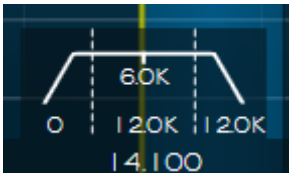
28.6.4 Filter Control Widget



The Filter Control Widget is used to adjust the high cut and low cut of the Receive Filter. To initiate the Filter Control Widget, hover your mouse over the Carrier Frequency just above the horizontal axis Frequency bar. This will cause the Filter Control Widget to appear. Within the control there are three sections separated by dotted lines.

- If you hover your mouse over the left section a left Control arrow will appear. Clicking and dragging left or right will adjust the low cut of the filter and will display as the left side of the Receive Filter moving left or right. The measurement at the bottom displays the separation from the carrier frequency.
- The center section adjusts both the high cut and low cut of the filter simultaneously. Hovering over the center section will display a four way arrow. Clicking and dragging up and down from within this section will decrease/increase the low cut while increasing the high cut of the filter effectively making the Receive Filter bar wider. Clicking and dragging left and right will move the Receive Filter bar left and right relative to the Carrier Frequency.
- If you hover your mouse over the right section a right Control arrow will appear. Clicking and dragging left or right will adjust the high cut of the filter and will display as the right side of the Receive Filter moving left or right. The measurement at the bottom displays the separation from the carrier frequency.

28.6.5 Slice Flag

The Slice Flag contains all of the controls and information related to the individual Slice. The Flag will follow the Slice for easy access.

- The Close Button will remove the slice from the panadapter and will no longer be accessible for receive or transmit audio.
- The Lock Slice button will lock/unlock the slice tuning. When blue slice tuning is disabled. This feature is useful to prevent accidental tuning.
- The Quick Record button will record the receive or transmit audio of the respective slice receiver. When a file has been recorded the quick play button will change from Grey to Green. Pressing the quick play button will play back the recorded audio. When the radio is in transmit the recorded audio will be played through the transmitter.

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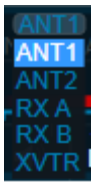
- Receive Antenna dropdown 

is the far left blue dropdown. It allows for easy control over which antenna is being used for the receive audio. Changing the antenna on the slice will change the antenna on the panadapter menu and any other slices within the panadapter.
- Transmit Antenna dropdown

is the red dropdown to the right of the receive antenna dropdown. It allows for easy control over which antenna is being used for the transmit audio. This selection is unique to the slice and changing it will not affect the panadapter or other slices.
- To the right of the transmit antenna dropdown is the Filter Bandwidth Annunciator

. This displays the current bandwidth of the Receive Filter in KHz measurement.
- Following the Filter Bandwidth Annunciator is the Transmit Button

which will toggle Transmit (TX) on and off for the individual slice. When transmit is enabled on the slice the button will highlight red

. You can move the transmit capabilities between slices by clicking the Transmit Button on another slice.
- When clicked, the Slice Indicator

will collapse the Slice Flag for an unobstructed view of the panadapter. This is commonly used when a panadapter has a small width and height dimension. When collapsed you will see the Letter Indicator remain and a new TX Button appear

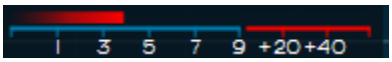
. The TX button behaves the same way as the larger version

.
- Below the Antenna Dropdown Menus there are three DSP (Digital Signal Processing) annunciators.

When illuminated in blue it is indicating that the corresponding function is enabled

. NB = Noise Blanker, NR = Noise Reduction, ANF = Automatic Notch Filter.
- The

indicator shows when you are in an arrangement that supports QSK operation. When illuminated in blue, you are in a supported setup.
-

The Frequency Display is consumes the largest portion of the Slice Flag. It represents the frequency of the Carrier of the individual slice. Clicking on this display will enable manual keyboard input of the desired frequency.
- 

The S-Meter shows the power within the Receive Filter as measured in S-Units (6 dB per S-Unit).

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28.6.6 Slice Menus

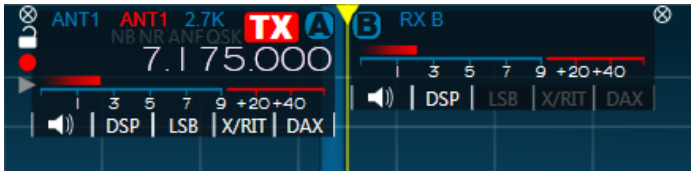
In this section of the Slice Flag are a series of menus for adjusting the slice settings. Greyed out menus indicate menus that are not yet implemented.

-

Clicking on the Slice Audio menu button will expose the Slice specific audio controls. Right clicking on the Slice Audio menu button offers a shortcut for muting audio without having to enter the menu. The Slice Audio Menu includes a Mute button and volume slider to adjust the audio level of the slice. A Left and Right balance button and slider to adjust the balance between left and right channels for headsets or speakers. Automatic Gain Control (AGC) dropdown menu allows the user to select Fast, Medium, Slow and Off AGC settings. Finally, the slider to the right of the AGC dropdown controls AGC Threshold.
-

The Digital Signal Processing (DSP) Menu contains Noise Blanker (NB) On/Off and slider, Noise Reduction (NR) On/Off and slider, and Automatic Notch Filter (ANF) On/Off and slider. When these controls are enabled they will illuminate the annunciators on the slice flag in blue . When the slice is in CW mode the ANF button and slider will switch to an APF button and slider. Clicking on the APF button will enable the Audio Peaking Filter. The slider will adjust the Audio Peaking Filter bandwidth. This function can be useful when trying to copy weak CW signals.

When operating a FLEX-6700 an additional control will appear to initiate Diversity Reception . This will overlap two synchronized receivers on the same frequency which will operate on two different antennas for simple diversity reception. The slaved slice will have a slice flag with reduced functionality. To hear the reception enhancement achieved using the diversity feature, you must listed using stereo headphones. Using stereo speakers can result in phasing nulls due to the lack of audio isolation between the left and right audio channels.



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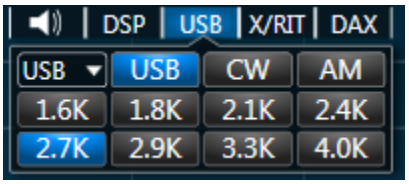
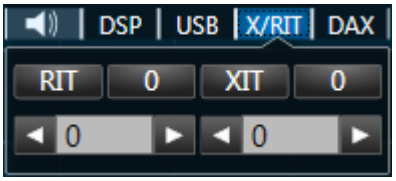
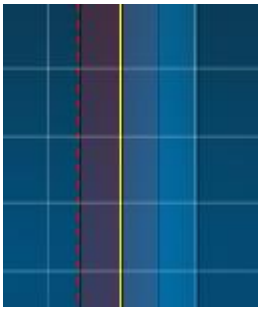
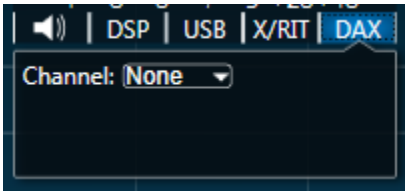
- 

The Mode Menu button displays the mode that is currently selected. Inside the menu there is a Mode dropdown menu and three quick select modes. To change the quick select modes to a different mode use a right click to expose a dropdown menu of available modes. Beneath the mode select buttons are the mode specific Filter Presets.
- 

The X/RIT Menu has controls for RIT and XIT. You can enable RIT or XIT by clicking the corresponding button. When enabled the button will turn blue. Modify the offset by clicking the right or left arrows or by typing in the text box. Click the

button to clear the offset. You can also control RIT and XIT on the FlexControl by clicking the AUX1 button to enable RIT and AUX3 for XIT. Double click the tuning knob to zero out the RIT/XIT. Double click the corresponding AUX button to disable RIT/XIT.
    - When RIT/XIT is set to something other than 0 the slice's transmit filter bandwidth will be displayed on the panadapter as a red bar. The bar is located behind the receive filter and will often overlap as shown below. Also, when RIT is adjusted a red dotted line will appear to show the original location of your receiver to where your slice will return upon zeroing out RIT.



- 

In the DAX menu there is a selection for your DAX Audio Channel.

28.7 SMARTSDR TRANSMIT CONTROL PANEL

The SmartSDR Transmit Control panel contains the controls and metering required for optimal FLEX-6000 RF transmission. The SmartSDR Transmit Control Panel consists of two sub panels; the global RF Power/ ATU Control Panel and depending on the demodulation mode of the Slice receiver that is enabled for transmit, mode specific controls are also displayed. There is a CW and Phone/Digital mode specific transmit sub panels.

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28.7.1 How to Access the Transmit Control Panel

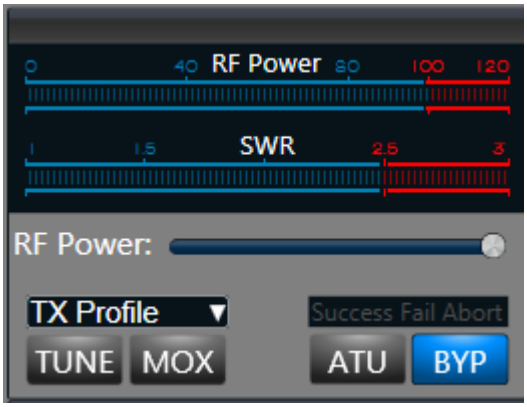
To display the Transmit Control Panel click on the Transmit Control Panel icon in the lower left hand corner of the SmartSDR application window.

28.7.2 Open and Close Panels

To open or close a panel click on the corresponding indicator at the top of the Transmit Control Panel

. When the button is illuminated in blue the panel is open and grey when closed

28.7.3 RF Power / ATU Control Panel (global)



- **RF Power bar meter:** This meter is an indication of the peak RF power being transmitted
- **SWR bar meter:** While transmitting, the SWR meter will measure the ratio of peak voltage on the minimum amplitude of voltage of standing wave, or VSWR. This is an indication of the radiated RF power efficiency. If a VSWR greater than 3.0:1 is displayed, stop transmitting and investigate the impedance mismatch of the antenna system connected to the FLEX-6000, as this could indicate a faulty antenna, coax or coax connectors.
- **RF Power slider control:** Moving the slider control to the right increases the RF power output. A value of 0 will not produce any RF output. The scale, from 0 – 100 approximates RF output wattage.
- **TX Profile Dropdown:** This dropdown allows the user to quickly toggle between different TX Profiles that have previously been created.
- **TUNE button:** Clicking this button will cause the transmitter to output a sinusoidal tone at low wattage (10 watts by default) for running external automatic antenna tuners and amplifiers. While TUNE is enabled, the output wattage can be adjusted using the RF Power slider control.
- **MOX button:** Clicking this button will key the transmitter. Clicking the MOX button while enabled will turn off or unkey the transmitter.
- **ATU button:** Clicking this button will initiate a tuning sequence by the internal Antenna Tuning Unit (ATU). If successful, the button will stay illuminated and the Success message will be displayed in the ATU Tune Operation Indicator. If the tuning operation fails to find a better impedance match, the ATU button will turn off, the BYP (Bypass) button will illuminate and either the Fail or Abort message will be displayed in the ATU Tune Operation Indicator.

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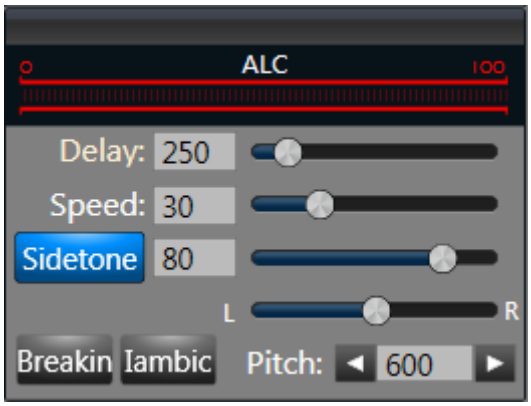
- **BYP button:** This button, when illuminated indicates that the ATU is in Bypass mode. If the ATU is active, indicated by the ATU button being illuminated and the BYP button is clicked, the ATU will be placed in bypass mode.
- **ATU Tune Operation Indicator:** This annunciator display will indicate the result of an ATU tuning operation, where the possible outcomes are Success, Fail or Abort.

28.7.4 CW Transmit Control Panel



- **ALC bar meter**: This meter is an indication of the analog ALC hardware input levels provided by external power amplifiers. If there is ALC being displayed, the external power amplifier is notifying the exciter (FLEX-6000) to reduce the drive level.
- *NOTE: When operating on Phone mode, if hardware ALC is indicated, the default RF Power and SWR meters will be momentarily hidden and the ALC meter displayed indicating a positive ALC condition exists.*
- **Delay Slider:** Moving Delay slider control the slider control to the right increases the time delay in milliseconds (ms) between the end of a keying element and when the radio transitions from transmit to receive. This effectively controls the QSK characteristics of the radio, where a value of 0ms is full break. Increasing this value will allow different degrees of QSK (semi break), such as listening between letters or words while sending.
- **Speed slider:** Moving the slider control to the right increases keyer's word per minute (WPM) setting. Moving the slider control to the left decreases keyer's WPM setting.
- **Sidetone Button:** Enables or disables the CW Sidetone.
- **Sidetone Slider:** Adjusts the volume (or amplitude) of the CW note. Moving the slider control to the right increases the volume. Moving the slider control to the left decreases the volume.
- **Sidetone Pan Slider:** Moving the Sidetone Pan Slider will adjust the sidetone from left to right channel audio.
- **Breakin button** (ON by default): Clicking on this button will enable or turn on the transmitter by a key or paddle closure rather than using PTT
- **Iambic button** (ON by default): Clicking on this button will enable the Iambic keyer. Disable the Iambic keyer if using a straight key.
- **Pitch increment / decrement control:** Clicking on the < or > buttons will decrease or increase the CW pitch frequency (tone) in 50 Hz increments

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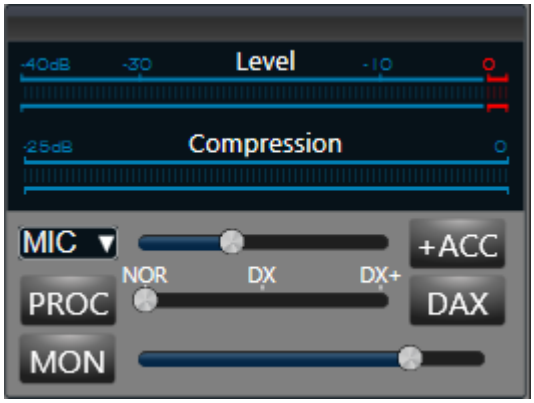
28.7.5 Phone Transmit Control Panel



- **Level bar meter:** This meter shows the real-time audio input level in dB from the selected audio input. A peak level of approximately -10 dB is the optimal target for fully modulating the radio. Never exceed 0 dB.
- **Compression bar meter:** This meter shows the real-time level of compression being applied to the input signal when the audio compressor (COMP) is enabled.
- **Audio Input drop down** (MIC is the default): Clicking on the dropdown box will display the audio input options of MIC, BAL (XLR balanced input) or LINE (TRS line level balanced input) for operating phone and digital modes, DAX (Digital Audio eXchange) for digital mode operation using third party software
- **Audio Gain slider control** (to the left of the Audio Input drop down): Moving the slider control to the right increases the amount of transmitter audio gain and is shown by the Level bar meter. Moving the slider control to the left decreases the audio input gain.
- **ACC button:** Clicking this button will enable audio input and output on the ACC connector on the rear of the FLEX-6000
- **DAX Button:** Clicking the DAX button will enable input from Digital Audio eXchange.
- **Processor (PROC) button:** Clicking on this button will enable the DSP speech processor resulting in additional talk power. The speech processor may be on or off and has three different settings if turned on. In the NOR or normal setting, the processor provides minimal additional gain and simply prevents audio peaks from clipping or producing excess power (than what has been set). In the DX setting, more gain is provided to the audio to increase the overall sideband envelope which results in a stronger signal that may be more readily heard at a distance. The DX+ setting adds more gain and compromises audio fidelity for readability by reducing the audio bandwidth. DX+ will always have a less pleasing sound to the ear and should not be used when the receiving end can copy your signal well. It will help with readability and strength in weak signal situations.
- **MON button:** Clicking this button will enable the audio input monitor while transmitting, allowing the operator to hear the audio signal being sent to the transmitter in real time.
- **MON Slider:** Moving the slider control to the right increases the monitor volume for your transmit audio. Moving the slider to the left decreases the monitor volume.

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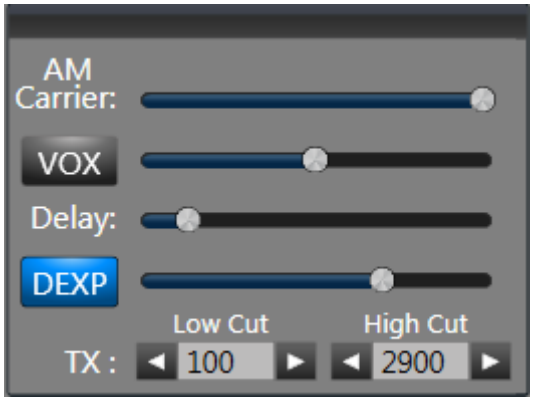
28.7.6 Voice Mode Panel



Carrier Slider: adjusts the AM Carrier Level that is used by the radio. Sliding the control to the right will increase the carrier level while sliding to the left will decrease the level.

Voice-Operated Transmit (VOX) button: When the VOX is on, the sound of your voice will automatically switch the transceiver into the transmit mode. When enabled the VOX button will illuminate blue.

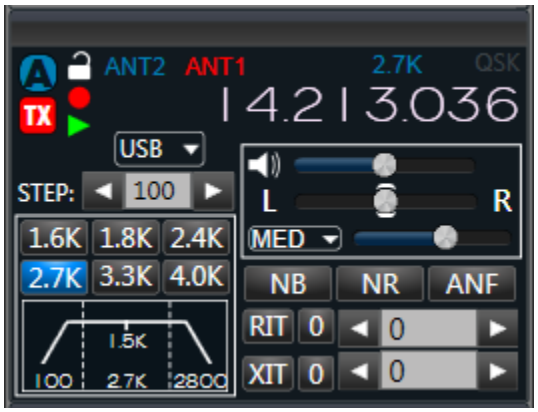
VOX Level Slider: will increase the audio level at which transmit is engaged when dragging the control to the right and decrease when dragging to the left.

Delay slider: adjusts the delay between the end of the voice to when the radio switches back to receive mode. Sliding the control to the right will increase the delay while sliding to the left will decrease the delay.

Downward Expander (DEXP): Reduces the audio level by a specific ratio when under the threshold level which is usually used to cut out background noise from entering the MIC.

TX Low Cut and High cut: allows the user to set the low end cutoff and the high end cutoff of their transmit bandwidth.

28.7.7 Active Receiver Panel



The Active Receiver Panel mirrors the controls of the active receiver. For a list of the controls and their function see the Slice Flag Section of this manual. The tune step control is the only control that does not also reside on the Slice Flag

. You can adjust the size of your tune step by clicking the right or left arrows. This will alter the step size of each click of the mouse wheel and Flexcontrol. It will also change the snap tune function for drag tuning and click tuning. When a Slice is moved it will automatically snap to the nearest round number at the chosen step size. This information is remembered on a per-Slice basis.

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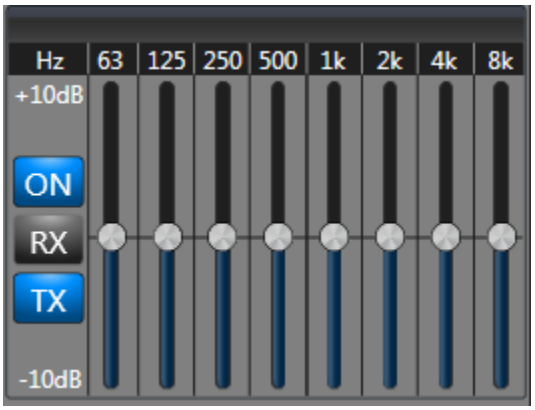
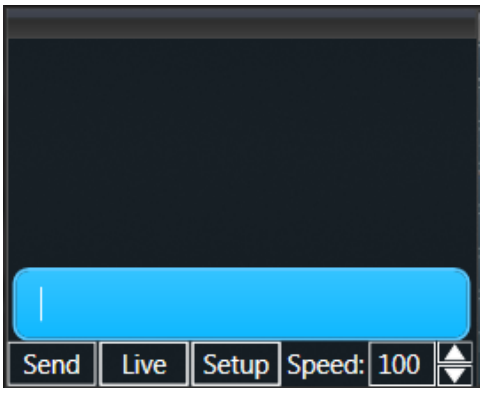
28.7.8 Equalizer Panel



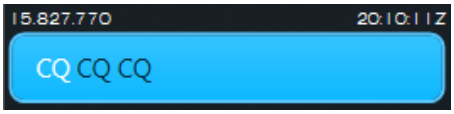
The Equalizer Panel allows the user to adjust the receive and transmit equalization for the radio. Toggle between Receive RX and Transmit TX by clicking on the corresponding button. The ON will enable (Illuminated Blue) or disable (Grey) the equalizer. The eight sliders will adjust the corresponding channel listed at the top of the panel. The slider allows for adjustments +/- 10 dB.

28.8 SMARTSDR CWX PANEL



CWX is a keyboard entry method for CW operation. The user will type a message into the blue text bubble to be sent by the radio. There are two methods of sending messages "Live" and "Standard"

- **Live mode** of operation is enabled when the Live button is highlighted in Red. Live While in live mode, text will be transmitted as the user types into the text bubble.
- In **Standard mode** the text will not be transmitted until the user hits the "Send" button or presses the "Enter" key.



As text is transmitted the font color will change from black to white indicating that the transmission has occurred. The user can stop transmission at any point by pressing the "Escape" key on the keyboard or tapping your paddle or key.

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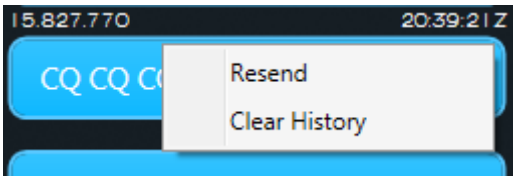

After a message has been sent the user can right click on the sent message to bring up a context menu that allows the user to resend the message or clear the history of the conversation.

CWX also supports several prosigns that can be entered in the CWX text bubble.

To insert Prosign BT use =
To insert Prosign AR use +
To insert Prosign KN use (
To insert Prosign BK use &
To insert Prosign SK use $

The user can quickly control the transmit speed by clicking the up down arrows next to the speed control or directly typing into the text box.

Clicking the "Setup" button

will reveal the Setup Panel which contains a delay control 12 Hot Key presets for preset messages. The "Delay" control adjusts how long after the end of a transmission until the radio will return to receive mode. This is measured in milliseconds. For QSK operation the Delay should be set to a low value while a high delay setting will keep the radio in transmit between characters or words.

The Hot Key messages can be set by typing directly into the text boxes next to the F1 – F12 buttons. Once the message is set the user can press the corresponding key on the keyboard to automatically send the message. A Hot Key message can also be set from the Text Bubble by pressing Ctrl+ F1 – F12 after text has been entered.

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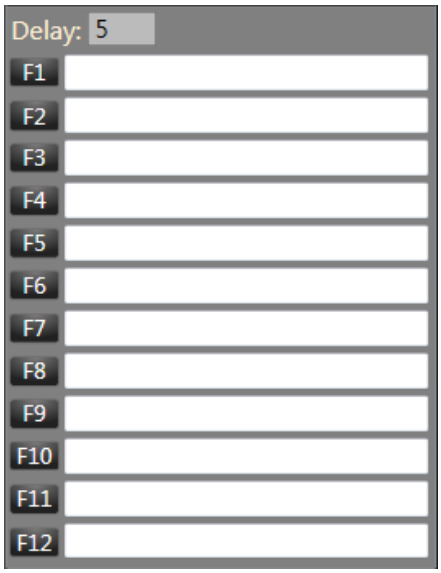

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